

Storage Industry Predictions 2022

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Summary of vendors' predictions for 2022

Like every year, [StorageNewsletter](#) asked vendors for their 2022 perspectives. Based on a strong exercise to collect vendors inputs and find out some leading topics, we identified the following top predictions from these 53 answers :

1. By far, the #1 prediction is related to **Cloud and Edge** in all its forms, hybrid and multi, coupled with the operating and charge model.
2. Second topic is represented obviously by **Cybersecurity** and its strong threat **Ransomware**. It comes after 2021 when we have seen significant attacks.
3. Very close we identified **AI/ML and GPU** and everything related to **Data Protection** at large.
4. **Object storage** and especially used in the container Kubernetes environments arrived in 4th position.
5. and finally **cloud-native, container and Kubernetes**.

Acronis (Candid Wüest, VP of cyber protection research)

Ransomware affecting your daily lives

Ransomware is one of the most profitable cyberattacks at the moment. Despite some recent arrests, there is no end in sight. Ransomware will expand further to MacOS and Linux, as well as new environments such as virtual systems, cloud and OT/IoT. Anything that is connected to a reachable network is a potential target. This will increasingly lead to consequences and impacts in the real world, and thus also to more demand for official regulations and sanctions. Stealing data for double extortion as well as disabling security tools will be the norm, but it will also become more personal with insider threats and personal data. The chaos will continue as groups keep rebranding to defy investigations and ransomware-as-a-service will get smaller tier groups allowing for overlapping usage of different families.

Data breaches for everyone

Despite the increase of data privacy regulations, the number of reported data breaches will continue to increase. This is not just because they have to be reported, but because of the complex interactions and IT systems. Many companies have lost the overview of where all the data is and how it can be accessed. Automated data exchange from IoT devices and M2M communications increases the spread of data further. Unfortunately, we expect to see many large-scale data breaches in 2022. These data leaks will enable attackers to enrich their target profiles easily.

API attacks

Cloud services are booming and so are serverless computing, edge computing and API services. In combination with container orchestrations like Kubernetes, processes can be efficiently automated and dynamically adapted to the circumstances. Attackers are trying to disrupt this hyper automation by going after such APIs, which can seriously impact the business processes of a company.

Alluxio (Haoyuan Li, Founder and CEO)

Hybrid Cloud a Reality & Multi-Cloud Strategy a No-Brainer

We've already seen a hybrid-cloud strategy with multiple data centers and public cloud providers emerge as the standard for large enterprises as the operational toolset continues to evolve and simplify cloud migrations. In 2022, we will see organizations grow their digital footprint by embracing the hybrid and multi-cloud model to enjoy elasticity and agility in the cloud, while maintaining tight control of the data they own. Cloud vendors will keep innovating and competing with differentiated

capabilities in network connectivity and physical infrastructure improvements because organizations wouldn't want being locked-in.

Mainstream AI and Deep Learning

As the toolset for AI applications continues to evolve, machine learning and deep learning platforms have entered the mainstream and will attain the same level of maturity as specialized data analytics. Just like we currently see a plethora of fully integrated managed services based on Apache Spark and Presto, in 2022 we will see vertical integrations emerging based on the likes of PyTorch and Tensorflow. MLOps for pipeline automation and management will become essential, further lowering the barriers and accelerating the adoption of AI and ML.

Services for Everything

Operational complexity was the demise of Hadoop on-premises. Cloud services offer the ease of elasticity of infrastructure provisioning with little operational costs. In 2022, we will see the emergence of managed services not just for cloud environments but also hybrid-cloud and on-premises deployments to eliminate complexity from integrations of myriad components such as data catalog, data governance, computational frameworks, visualization and notebooks.

Data Sharing Across the Cloud

With SaaS and managed services in the cloud creating data silos, improved governance and catalog with a data fabric spanning multiple services will come to the rescue in 2022. Sharing data across tenants and multiple service providers efficiently and securely will make data exchange easier than ever before.

Rise of Table Formats for Data Lakes

New stack both in the storage and the compute layer keeps innovating. Data Lakes are rising to prominence and structured data is transitioning to new formats. In 2022, open-source projects like Apache Iceberg or Apache Hudi will replace more traditional Hive warehouses in cloud-native environments, enabling Presto and Spark workloads running more efficiently on a large scale.

Arcserve (Shridar Subramanian, CMO)

It is more important than ever to protect business data from damage, destruction, or attack in today's hyper-connected digital economy. Indeed, it is not an exaggeration to say that the viability of every business now depends on constant access to its critical systems and data.

Of course, managing and protecting your business data is no easy task. You must constantly monitor the changing data landscape and be alert to new tools and challenges. You must be aware of ever-evolving privacy regulations and security threats, which may appear from anywhere around the globe.

What changes does 2022 hold? Here are four emerging trends that will shape the way companies approach data protection and management in the year ahead.

The attack surface will continue to expand as ways of working evolve

Your attack surface includes all the possible ways an attacker can get into your company's devices and networks and lock up or exfiltrate your data. So, it's essential to keep your attack surface to a minimum. The problem is that your attack surface is continually growing as more people work remotely on multiple devices and create more entry points for cybercriminals to carry out cyberattacks. Worse still, the attack surface is constantly changing. It isn't a single surface but many disparate fragments. Furthermore, control of endpoints is becoming increasingly complex as employees leave organizations and retrieval of equipment becomes harder.

The bottom line is that breaches will inevitably happen. And in the coming year, companies will have to do a better job of recognizing breaches so they can extricate themselves as quickly as possible. Security and recovery strategies must be more thorough. As the attack surface expands, those strategies must cover not only your on-premises data but data in the cloud, at the edge, and everywhere in between.

Data sovereignty will create even greater complexity for data management

As companies have grown globally and become more interconnected, the rules around data privacy have become far more complicated. For example, a company based in Germany may use a U.S.-based company like Amazon or Google to store and send data. The question is, where does that German company's data legally reside, and by what rules is it governed? The answers to these questions are complex and unclear. Global experts of IT, legal, and HR are discussing passionately how to interpret our constantly evolving reality of data processing. That's why 86% of IT decision-makers say their organizations have been impacted by changing compliance requirements for data privacy, according to a global survey conducted by Dimensional Research.

Companies no longer have a single data lake at their corporate headquarters that IT can focus on protecting. These days, much of their data resides in the cloud, which means they have a globally distributed data infrastructure. They must keep track of sovereignty issues in different jurisdictions, and to do this, they will need help. Cloud providers will have to work more closely with their customers to manage sovereignty and compliance with varying rules.

In the year ahead, the onus will be on both businesses and public cloud providers to improve compliance and data sovereignty issues by better understanding what is in the petabytes of data they're storing and the regulations around every element of that data. Businesses can no longer be satisfied by simply backing up data. They will have to get smart about their data content and put policies in place around that content.

Global supply-chain issues will become a data-protection issue

Supply-chain issues are creating significant disruption to the global economy, with everything from cars and refrigerators to semiconductors and toys in short supply. And those issues look likely to continue well into 2022. In fact, in a new survey of CFOs compiled by Duke University's Fuqua School of Business and the Federal Reserve Banks of Richmond and Atlanta, a majority of the CFOs expect the issues will not be fixed until the second half of 2022 or later.

Logistics issues and digital risks such as cyberattacks will cause further disruptions to the global supply chain in the coming year. In 2021, the Colonial Pipeline ransomware attack took down the largest fuel pipeline in the U.S. and temporarily caused fuel shortages up and down the East Coast. The company paid the hackers nearly \$5 million in ransom just a day after discovering malware on its systems. The supply chain will remain a top priority for organizations in 2022. That means they will need to be actively armed with data protection solutions to keep the supply chain working and meet the demands of their customers. Specifically, organizations will need to ensure that cyberattacks do not further compromise their supply chains and that data remains available 24/7 and can be instantly recovered.

The Data Protection Officer will grow in strategic importance

The Data Protection Officer (DPO) is an enterprise security leadership role that, under certain conditions, is required by the General Data Protection Regulation (GDPR). In fact, according to the latest GDPR stats, the demand for Data Protection Officers has risen by over 700% over the last five years. Data Protection Officers are responsible for having expert knowledge of data protection laws and practices while overseeing their company's data protection strategy and ensuring compliance with GDPR requirements.

The role of the DPO is poised to grow in strategic importance in the coming year, particularly as the responsibilities of DPOs extend beyond traditional IT to encompass a holistic view of data privacy, security, and education. The DPO can even open new opportunities across the organization. For example, in a world of remote work, the DPO will be a strategic enabler for business, especially as it becomes clear that the virtual workforce is here to stay.

The challenge of data protection is sure to become even more daunting in 2022 and beyond. As companies store more data across on-premises, cloud, hybrid, and

third-party systems-and as data regulations grow and multiply-companies must stay on top of the ever-evolving data landscape or risk sinking altogether.

ATTO (Tim Klein, president and CEO)

NVMe deployment in enterprise environments gained traction in 2021 and I fully expect that to continue in 2022. One development that will propel NVMe adoption will be how manufacturers develop ways to work with or around NVMe's limitations, in particular scalability and management. Also, the growing availability of PCIe 4 hardware will be helping in accelerating NVMe adoption in enterprise environments.

Fibre Channel saw growth in 2021 and that trend is expected to continue next year with the distribution of new PCIe 4 and Gen 7 products and maturation of new technologies like NVMeOF (NVMe over Fibre Channel). Indeed, NVMeOF has quietly become a strong alternative to NVMe over Fabrics (NVMe over Fabrics) as system builders look for the best way to get the most from networked NVMe storage. Dell recently added support for NVMeOF in most of their storage products while NetApp has already had it. It would not be surprising to see more vendors explore this undeniably powerful union.

In **Ethernet**, we will continue to see an emphasis on offload technologies that help to increase performance, specifically offload technologies based on Remote Direct Memory Access (RDMA). Since RDMA-capable Ethernet adapters, aka SmartNICs, have been on the market for a while, the foundation has already been laid to expand upon the use of RDMA. Therefore, I expect to see RDMA-based protocols like RoCE (RDMA over Converged Ethernet) continue to be mainstreamed while solutions like Network File System over RDMA (NFS over RDMA) could emerge from the laboratory and generate greater market interest.

Catalogic Software (Ken Barth, CEO)

In 2022, we expect cyber criminals to launch new supply chain ransomware attacks on cloud storage and cloud data protection vendors in a similar one-to-many fashion to propagate malware to cloud storage systems. This is an escalation of ransomware attacks from a focus on primary data centers to the suppliers of data protection and cloud storage systems. A cyber resilient data management strategy includes not only securing your primary data, but also safeguarding your backup data sets, whether on site, on tape, in a public cloud, or in a backup vendor's cloud repository.

Cloudian (Jon Toor, CMO)

Data sovereignty concerns will create new opportunities for Managed Service Providers (MSPs)

Continuing privacy concerns in EMEA since the Schrems II decision invalidated the EU-US privacy shield are driving organizations to look for new options to protect data. MSPs in the EU will increasingly fill this need with locally based services that are entirely contained within geographic boundaries. Now-mature cloud infrastructure – compute, storage, and management – will facilitate this growth, creating a wealth of new options for customers.

Instead of migrating legacy apps to the cloud, organizations will create cloud-like environments on prem

Containers and cloud-native storage technologies have created new paths to building private cloud infrastructure. Now organizations can get the benefits of public cloud at less cost, with greater control, and with the option to extend infrastructure to the edge. Gartner projects that 75% of enterprise-generated data will be created and processed outside centralized data centers or the cloud by 2025, driving new requirements for data management and analytics at the edge. The private cloud will give organizations new options for deploying modern applications, allowing them to make workload placement decisions on economic grounds rather than a one-size-fits-all rush to the cloud.

New analytics and streaming APIs drive next generation edge use cases

Organizations are eager to explore next generation edge use cases. These use cases require the ability to rapidly process massive volumes of streaming data to enable real-time decision making. However, current analytics and streaming APIs do not support such advanced AI and ML at the edge. As a result, new edge-based devices that support the needed analytics and streaming data APIs will emerge in 2022. This will allow immediate processing of data locally at the edge, enabling AI and ML models to make those critical immediate decisions. In addition, to make these APIs easy for organizations to employ at the edge, new streaming feature stores will proliferate next year.

Commvault (Reza Morakabati, Chief Information Officer)

Over the next year, enterprises will launch new agile, DevOps-like teams to optimize how they manage and use their data. These teams – composed of data security,

protection, analytics and other types of data experts along with IT operations staff - will be tasked with quickly and efficiently improving the security, protection, governance, and value of their organization's data.

DevOps teams like this have been a staple of application development for years. Unlike traditional application development, which separated the software development and operations teams, these DevOps teams combine software developers with IT operations staff into a single group focused on application development and improvement. In doing so DevOps teams made it easier for enterprises to implement agile software development methodologies, shortening application development times and speeding the improvement of applications on an ongoing basis.

However, the past year has demonstrated that while the digital economy might run on applications, many of this economy's most valuable assets are the data collected and generated by these applications. It has also demonstrated that when enterprises do not secure, protect, govern, optimize and analyze this data on an ongoing basis, they not only risk ceding market leadership to those that do, but also put the fundamental integrity of their business at risk.

For example, criminals are constantly developing new, more sophisticated ransomware attacks that can lock this data, shutting global enterprises down for days or weeks. Government agencies are auditing enterprises' data privacy practices on an ongoing basis, with massive fines (and bad publicity) awaiting those enterprises that are not in compliance with current regulations. Enterprises also find themselves constantly needing to move or migrate data from on-premises to cloud, cloud to cloud, application to application if they hope to optimize operations and costs. Meanwhile, most market leaders today - ranging from Amazon to Coca-Cola, and Netflix to Marriott) are characterized by their ability to use their data to deliver better experiences to their customers than their competitors.

Thus the need for enterprises to deploy agile data teams that can quickly and continuously provide them with comprehensive visibility and control of the data they have sprawled across dozens of SaaS applications, multiple cloud services, and various types of on-premises infrastructure. Teams that shorten cycle times for new data solution releases, increasing the frequency of these releases so that the enterprises' other IT and business teams can experiment with them and quickly provide feedback on how well they help them manage and use data. Teams with the skills and speed needed to secure and protect this data, so they can fend off attacks from cybercriminals while also making sure, if a successful attack or another data disaster does occur, they can quickly and comprehensively recover their data. Teams that can rapidly move data from any application, cloud or infrastructure to any other application, cloud or infrastructure. Teams that will collaborate with work business

line employees to use the latest data analytics, AI, ML and other tools to glean valuable insights from this data - insights that these enterprises can use to better forecast product demand next holiday season, predict when a piece of IoT-enabled industrial equipment will need maintenance to prevent downtime, and improve other business outcomes.

These teams will not just be completing these data management and optimization projects and going back to their old jobs. Enterprises are always adding more applications and generating new data, cybercriminals are always developing new attacks, and customers' expectations are always changing. Which is why the new agile data teams enterprises created in 2022 will last well beyond next year, as enterprises continue to seek to accelerate how quickly cycle through the data environment changes needed to optimize how they store, protect, secure, govern, and use their data in today's dynamic digital economy.

CTERA Networks (Aron Brand, CTO)

The decline of centralized cloud computing

The first-generation model of centralized cloud computing and storage has now run its course, and most of the new opportunities for enterprise data management reside at the edge.

Data growth outside the data centre

Consider that 75% of enterprise data is created in branch offices, on mobile devices and by IoT-enabled smart devices. Such data growth outside the datacenter is the new reality, and it's creating a need for enterprises to deploy computing power and storage capabilities at the network edge, aka edge computing.

Powerful edge compute will result in more desirable devices

If you take your voice-based home virtual digital assistant from Amazon or Google. More powerful edge compute power would make these devices even more desirable, including:

- Improved response time: your Amazon Echo, Google Home or other smart speaker would perform speech recognition locally and deliver a faster answer
- Offline availability: whether there is a storm, a power cut or a cloud service outage, your device will still be up and running, or 'always-on' even when the network is offline

- Improved security and privacy: by minimizing the need to send sensitive information to the cloud, data privacy risks are reduced

DDN (James Coomer, SVP of Products)

Workload Aware Infrastructure – Intelligent Infrastructure (Storage) that can see more than just activity, but can react to specific, identified workloads

Data Processing Units – DPU – Novel architectures for delivering data with stronger price/performance, efficiency, and other features.

Shifting of organizations reliance upon HDFS for unstructured data onto scalable data platforms that are more open and flexible using S3 and file protocols.

DH2i (Don Boxley, CEO and Co-Founder)

In 2022, I predict that **Kubernetes and software defined perimeter (SDP) enhanced stateful containers will make multi-cloud the architectural standard for deploying containers.**

Why? Users get the vision of multi-cloud – the ability to use workloads across different clouds based on the type of cloud that best fits the workload. But this vision has typically depended on a VPN to connect multiple cloud environments. That's a problem because traditional VPN software solutions are obsolete for the new IT reality of hybrid and multi-cloud. They weren't designed for them. They're complex to configure, and they expose 'slices of the network,' creating a lateral network attack surface.

A new class of containers with integrated SDP security will emerge to eliminate these issues and disrupt the current deployment model for multi-cloud. This new SDP-enhanced container will enable organizations to build smart endpoint multi-cloud container environments that can seamlessly span clouds without the added costs and complexities of a VPN and with virtually no attack surface. The combination of Kubernetes and SDP-enhanced containers will enable organizations to build multi-Cloud Kubernetes clusters with unparalleled portability. This new multi-cloud deployment standard will make it easy for users to switch from one public cloud vendor to another.

This will be particularly true for the stateful database container use case. **With SDP-enhanced database containers, medium and large enterprise organizations will be able to achieve database-level high availability (HA) and disaster recovery (DR) with automatic failover in Kubernetes.** This will enable them to deploy stateful containers to create new and innovative applications while also improving operations with near-zero RTO to more efficiently deliver better products and services, at a lower cost.

Excelero (Jeff Whitaker, VP of Products)

In 2019 Gartner predicted that the future of the database market will be in the cloud. Yet as of 2021, despite digital transformation efforts, most core business applications have remained stuck on premises in the data center. We believe 2022 is the year of migration to the cloud for every application, from databases to ERP environments to core business applications.

In 2022, we'll see deployment of new storage technologies that debuted in 2021 such as Infiniband networking, NVMe drives and advanced software-defined storage capabilities that address the bottleneck when demanding workloads run cloud storage infrastructure. These new technologies deliver the performance and agility needed to meet the stringent goals of demanding workloads in analytics, AI/ML and databases - and enable IT environments to start generating business versus just being another cost center.

Container-based applications will become the predominant deployment model for mainstream applications in the cloud in 2022, as companies increase their use of Kubernetes for more than just CI/CD and web applications. With 90% of Kubernetes deployments now located in the cloud, public cloud environments will continue to advance their container-native infrastructure. In 2022 we will see container-first approaches in the cloud for mainstream, stateful applications, opening the door for transactional and data I/O applications to be deployed in containers.

FalconStor (Chris Cummings, VP of Marketing)

2021 was a year when IT groups tried to cope with and overcome COVID amplified IT challenges, adopted new cloud technologies and crossed their fingers in hopes that ransomware wouldn't invade their ranks. As 2022 arrives, IT groups will stare down the need to rationalize their new services and existing data center operations, get

more aggressive on the security front, and find new sources for IT talent lost, setting up a number of potential winners for 2022.

Managed Services Providers

Corporate IT will continue the major outsourcing push it started in 2020 when COVID kicked IT "out of the building" and completely took over data protection with Backup-as-a-Service and DR-as-a-Service offerings. Companies need help since many employees are still working from home while hiring new employees is getting harder and harder, so the relationships with MSPs will become more important. This will be even more urgent in specialized technology areas such as IBM and Power Systems, tape systems, and mainframe.

Ransomware Protection and Recovery

2021 saw many notable attacks, 2016 is widely regarded as the year of ransomware, and 2022 will set the new mark, bringing data protection and recoverability technologies into greater focus. Along with remote work, we saw an increase need for security and data protection at a global level and that will continue in 2022 as remote work is here to stay.

Hybrid Cloud

While the hyperscalers will remain on a growth tear and the media will fawn over multi-cloud, the Global 5000 will expand their hybrid cloud deployments, making technologies that span on-premises, colos, MSP clouds, and public clouds even more prized.

Immutable Data

Faced with attacks from many vectors - external threats, internal bad actors, and smart code, the need for immutable data solutions that eliminate intentional data manipulation will rise - in the cloud and on-premises.

Economics

The public cloud flywheel continues - more adoption generates greater economies of scale and lower the cost of service. The question is: will Google spend an even greater portion of its war chest to challenge AWS and Azure?

Flexify (Sergey Kandaurov, Founder and CTO)

If cloud computing hasn't already become an essential component of our global economy, check out this statistic from Gartner: by 2025, more than 85% of organizations will embrace a cloud-first approach. When you consider that cloud

storage of business-critical information is already a US\$61B market, it's easy to see how the market could reach US\$390B by 2028. That's a blistering 26.2% CAGR.

We originally built Flexify with this trend in mind. Flexify.IO is a cloud storage virtualization and migration solution that helps customers by simplifying migration and avoiding dependency on a single cloud storage provider. We believe we are well positioned to serve the needs of organizations who will find themselves seeking cloud-agnostic solutions as the following trends accelerate in 2022:

Cloud lock-in will be avoided at all costs

According to a recent study published by the IBM Institute for Business Value, only 3% of business executives across 29 industries reported using a single private or public cloud. The majority of enterprises choose a multi-cloud approach to avoid dependency on a single cloud provider and for the flexibility to run workloads and store their data where it best suits their needs.

Unfortunately, cloud lock-in is a huge challenge for business and application developers worldwide. Going forward, the anti-lock-in sentiment will become more vehement ("Vendor lock-in is evil!") and the demand for cloud-agnostic solutions will rise.

We've just scratched the surface of the data explosion to come

By 2025, the amount of data stored on cloud servers will surpass 175 Zettabytes, according to IDC. The COVID-19 pandemic already has driven more people online, and more people from developing countries are becoming part of the digital economy as telco networks expand. Plus, as 5G rollouts continue, the anticipated rise in IoT, IIoT and private 5G applications will have massive data storage implications. Businesses that can better harness the power of their data will have an enormous advantage over their competitors, and organizations that can leverage this data could potentially develop innovative solutions to humanity's most pressing needs. In 2022, organizations will amplify the search for solutions that not only store data but also enable access to that data when and where it is needed.

Cloud cost optimization will remain a top priority

The massive shift to cloud has been propelled by a value proposition that includes efficiency, scalability, economics and innovation. However, cloud costs are skyrocketing. Canalys reports that cloud infrastructure spending as of Q1 of 2021 had grown 35% year on year to reach US\$41.8 billion. According to a recent survey by Anodot, 30% of data and analytics professionals reported nearly a 50% increase in their monthly cloud bills over a six-month period last year. Sarah Wang and Martin Casado argue in their treatise "The Cost of Cloud, a Trillion Dollar Paradox" that "while cloud clearly delivers on its promise early on in a company's journey, the pressure it puts on margins can start to outweigh

the benefits, as a company scales and growth slows." It's no wonder then that cloud cost optimization has become a top concern, with Gartner reporting that 52% of infrastructure and operations leaders listed "lower costs" as one of their top three goals for 2021.

Cloud storage is certainly a part of those skyrocketing prices. Fortunately, we're also seeing commoditization of storage to a certain degree, with many smaller cloud providers catching up to the storage capabilities of the "Big 3" hyperscale cloud providers and offering more competitive pricing. Thus, the flexibility to choose any cloud to store data at any moment becomes a valuable weapon in the war on skyrocketing cloud costs.

Organizations have even more reasons to migrate data

Data protection and disaster recovery are two of the key reasons organizations migrate or duplicate their data on multiple clouds. But there are many more reasons why data migration is becoming a core cloud functionality, including the rise in data sovereignty requirements, the need to control costs, and moving data closer to compute resources and edge devices to improve performance and reduce lag times. In the coming year, all of these drivers for data migration services will become more intense, not less.

Talent shortages in IT will necessitate wise resource allocation, driving growth in third-party solutions

Everest Group reports that 86% of enterprises view the talent shortage as a key impediment to achieving their desired business outcomes, especially with respect to IT and digital enablement skills. With engineers in short supply, their time is too valuable to waste; therefore, organizations will focus their IT teams on service delivery and software velocity, rather than on building capabilities that are already readily available from third-parties. The market for cloud-agnostic, proven tools that can be either installed internally or managed as a service will be hotter than ever in 2022.

I'm looking forward to what the next year brings. All indications are that the data storage and migration trends are all moving in the right direction.

Fujifilm Recording Media USA (R. Gadomski, Head of Tape Evangelism)

Increasing Focus on IT Energy Consumption

According to the United Nations, irreversible damage has already been done to the

environment as a result of greenhouse gas emissions. Wall Street will increasingly demand sustainability reporting and action. Chief Sustainability Officers will put pressure on energy intensive IT operations, requiring use of renewables and energy conservation measures. Research shows that 81% of CIOs would consider alternative data storage options that are more cost-effective and sustainable. This will set the stage for new tape system deployments that can reduce TCO by more than 70% and reduce CO2 emissions by 95% compared to traditional HDD storage.

Return to Hybrid Cloud Strategies

COVID 19 created short term storage strategies often favoring a flight to cloud. However, long term thinking will favor hybrid cloud strategies where the best of public cloud plus on-prem private cloud provides maximum flexibility and value. This will especially apply to data accessibility, regulatory requirements, data governance, and cybercrime risks including ransomware. Today's modern automated tape solutions will provide the necessary benefits of cost, scalability, reliability and data protection to support this model.

Storage Optimization Will Be Key to Data Growth Management

With the continuing digital transformation comes the zettabyte age of storage where data to be stored globally will approach 6.0 zettabytes (ZB) in 2022 according to a leading IT industry analyst. Just one ZB would require 55 million 18.0 TB HDDs or 55 million 18.0 TB LTO-9 cartridges. Storage optimization, that is to say, getting the right data, in the right place, at the right time, and at the right cost will be critical for competitive advantage. Intelligent data management that leverages multiple tiers of storage, active archiving and innovative S3-compatible archive solution for object storage using tape will be required to effectively manage data that will only increase in value.

Hammerspace (David Flynn, co-founder and CEO)

2022 will be the year that data reaches every corner of the globe. In the world of computer hardware design, 2022 will signal a shift from commodity toward higher efficiency, special purpose design. This trend will change the face of the industry and favor logic design engineers. The most successful innovation companies will possess the talent not just to operate in scripting languages but to expand their talent to design hardware logic and optimize at a lower level within the hardware.

ARM will begin taking over x86 in the datacenter

Businesses who are able to harness the most compute power, fastest, will have a

competitive advantage. Through 2022, ARM will no longer be a datacenter toy but will instead be a mainstay. will quickly be quickly taking over x86 in the datacenter, enabling the most successful innovation organizations to harness new technology to leverage increased total core count, increased total processing power, and a reduction in processing power/watt. In the cloud, ARM-based options will deliver substantial savings on compute power compared with the X86-based options.

Custom designed chips will be increasingly common

Innovators can no longer depend upon Moore's Law to continue to accelerate compute performance at the same exponential pace that has been enjoyed in the past. No longer will it be possible to win the innovation battle with generic software depending on commodity hardware to run it at the speed needed. As Moore's Law slows down, big tech companies began designing their own chips for intelligence in products such as autonomous vehicles and cell phones.

Software engineering talent will be in short supply

The trend toward more efficient hardware design will require increasingly high-performance software locally where IT equipment is pooled in clouds or grouped in data centers.

Data will need to be a globally accessible resource

Work from home will frequently be defined not just as work from your house near the office, but to work from your home country. Data will need to be a globally accessible resource to the workforce while remaining high-performance locally to take advantage of the high-efficiency, special purpose hardware.

Edge will no longer be just for data capture, it will be for data use

Everything is now interconnected with the Internet of Things (IOT). Customers and workforce are now distributed around the world, and, soon most people will have broadband internet through SpaceX Starlink and Amazon's Kuiper Project.

Technology will solve problems previously considered the domain of governments

The adoption of cryptocurrency and bitcoin will be seen in more countries, enabling the people and technology to address problems on a local basis.

Innovators will more rapidly embrace patent open source

The most successful innovation organizations will accelerate pace of development through technology sharing in the open source community. By attracting large-scale participation and promoting a technology solution to peers, organizations embracing patent open source patents will see faster development and accelerated adoption.

There will be a reduced dependency on filing and litigating patents on all components of innovation as organizations master the art of accomplishing both speed of development and IP protection. Monetization of the engineering talent will come through advanced new products being sold, not through protection of a patent portfolio.

The most notable innovators will be focused on attracting the best engineering talent who can take advantage of the rapid innovation in open source and build new solutions advancing and leveraging it. There will be a continued gravity pulling the best engineering talent into a small number of organizations who are delivering new concepts to the market.

Examples: Tesla and then Toyota outsourcing self-driving software, Linux, and, Cloud Native Compute Foundation

The combination of advancing technology to connect all corners of the world with data, the move of the workforce to home countries, and the availability of decentralized digital currency will make 2022 a monumental and game changing year.

And, I'm not saying that protecting innovative ideas with patents is bad, or the time ill spent.

Patents are to help others learn how to do things later. But, I am saying that yet more it is important to focus on the rate of innovation and time to market with those innovations.

HYCU (Simon Taylor, Founder and CEO)

Ransomware will continue to take center stage in 2022

Beyond the obvious where ransomware attacks happen more and more and at an accelerated rate than ever before, on average an attack occurs every 11 seconds, ransomware attackers will find more ways to exploit vulnerabilities to achieve their nefarious plans. If the recent Logjam vulnerability taught IT anything, it's that unanticipated occurrences heighten the need to better prepare, respond and recover in the inevitable event of an attack.

Data silo proliferation accelerates need for native data protection

With the emergence of containers, modernization of IT and the continued digital transformation organizations address, more data silos will exist within companies

than ever before. With the average of 8,000 to 10,000 SaaS-based applications in use as well as the rise of cloud platforms (on average most organizations deploy 4-5 cloud platforms within their organization, the need for backup and recovery that is native, and runs as a service, to support modern applications, databases and workloads will accelerate.

Advancements in data management help control cloud economics

With the rise of automation, artificial intelligence (AI) and advanced analytics, the use of these technologies to help companies identify, use and manage data from on-premises to public cloud environments will advance as well. The ultimate benefit will go to the end user so they will be able to better manage, predict and control costs.

Index Engines (Jim McGann, VP Marketing & Business Development)

Cyber criminals will get smarter

We saw cyber criminals slip in malicious code into a routine software update in the SolarWinds attack, but that was 2020. Cyber criminals will continue to find new, innovative ways to penetrate the data center and circumvent end-point solutions. Their goal: do as much damage as possible and make it hard and expensive to recover. In October, ZDNet reported a new strain of malware that can encrypt a corporate system in less than three hours. It capitalizes on the new remote work spaces, breaking in through TeamViewer and deploying within 10 minutes.

Volume of attacks continue to increase

JBS Meats, Colonial Pipeline, Air India and CWT Global made massive headlines and drew record-breaking ransoms. Why would cyber criminals stop now? It's a lucrative business and attracting more hackers into its criminal enterprise. And now, no hacking skills are required. Angry employees, disgruntled patients and anyone with a grudge can command a cyberattack using Ransomware-as-a-Service such as Conti, which already has over 400 attacks linked to it, according to the FBI. It's truly going to get worse before it gets better.

Attack vectors will get more sophisticated

Cyber criminals are deploying more sophisticated attack vectors and corrupting data in new ways. Lockfile ransomware was brought to light this past July, doing something unique in the field of ransomware, "intermittent encryption." This method evades detection of many standard detection tools that do not check the integrity inside file content. Other attack vectors also cause significant destruction while avoiding detection. Jigsaw uses encryption combined with a progressive deletion

and CrypMIC corrupts files without changing the extension. We will see more attack vectors that corrupt data in sophisticated ways in order to circumvent basic analytics tools.

Backups will be targeted

Again, cyber criminals are trying to do as much damage as possible to make organizations as desperate as possible and demand as much money as possible. Disabling, erasing and encrypting backups will hinder any attempts by organizations to recover. Standard data protection leaves organizations' backups vulnerable and cyber criminals know it. Among those is Conti, who anyone with funds can elicit, and can execute 160 commands including net stop "Veeam Backup Catalog Data Service" /y which, as it sounds, stops Veeam backups. The FBI already warned "Malicious actors have also added tactics, such as encrypting or deleting system backups – making restoration and recovery more difficult or infeasible for impacted organizations."

In 2022, relying on backups that have not been analyzed to recover from a ransomware attack is no longer a viable strategy.

Organizational down time will increase

Average down time is now 23 days, up by two days in 2021. This will continue to increase causing considerable disruption to businesses and infrastructure. Forget the ransom, that's only the beginning. Days and weeks of employee work are gone, orders can't be processed, labor is delayed, cattle can't be fed... and if an organization is trading publicly.

Infinidat (Eric Herzog, CMO)

In 2022, the incorporation of AI technologies across storage systems and software-defined storage will deliver superior value, dramatically save on CAPEX and OPEX, and improve real-world performance across all applications and workloads. I predict that this trend will harness the full power of AI for your storage estate. In 2022, AI will be used to build storage systems and software-defined storage.

The shift to hybrid cloud and container technologies will continue to proliferate at an accelerated pace in 2022. With many workloads moving to a hybrid cloud configuration, it will be imperative to have the infrastructure that supports core, edge and cloud, as well as the virtualization layer and the container layer across a hybrid environment. This will enhance the ability of enterprises to deliver the right end-user services with the right SLAs for their business. The importance of possessing hybrid cloud integration capabilities will substantially increase in 2022. I also predict that we

will see cyber resilient storage enhancements being adopted, such as logical air-gapping (both local and remote), which is an essential part of a hybrid cloud cyber security strategy.

Pressure for enterprise CIOs to substantially reduce costs will only increase in 2022, given economic fluctuations and business uncertainties. IT leaders will scramble to find ways to take costs out of their systems infrastructure. Due to high performance and low latency in a software-defined storage architecture, an increasing number of organizations will be able to consolidate multiple workloads onto a single storage array in 2022, dramatically cutting CAPEX and OPEX. No need for 50 different arrays each running one application or workload, when – with 2022 enterprise storage solutions – all 50 of those applications and workloads can fit on just one or two storage arrays. Storage will be key to the reduction of OPEX and CAPEX for infrastructure in the new year, saving on watts, slots, power, cooling, floorspace, and operational manpower.

Inspur (Alan Chang, VP, Technical Operations)

Enterprises have traditionally embraced high performance computing (HPC) and made it a part of their applications. HPC provides the speed that enterprises need for processing in certain scenarios. Some specific use cases include the use of high frequency training on Wall Street and genome decoding in the pharmaceutical industry, any industry that needs fast calculations.

What we see on the horizon and predict for HPC is the blending in and optimization of machine learning and artificial intelligence into the technology. Previously, HPC code was not universally portable and there were other rules that had to be met. But for today's application of machine learning and artificial intelligence in a high-performance computing environment, we are able to ask questions we have never been able to ask before and we receive the answers more quickly than we have ever anticipated.

When we step back and compare where we are now opposed to 10 years ago, it's clear to see that the Open Compute Project is headed in a healthy direction. There are myriad subgroups with concentrations on different topics of the dataset. A decade ago, the OCP was laser focused and emphasized the hardware itself and how it would fit in certain environments. Today, we have so many interesting subgroups that focus on immersion cooling, open firmware and so much more.

Most critically, open-source firmware is gaining momentum. And our next prediction is that 2022 will see a major gain in traction for it. Firmware is the most powerful

software that runs on a platform. And the majority of it is closed-source-but that is changing. Open-source firmware is on the side of the end user, regardless of the cloud service provider or enterprise. There are so many important reasons for the use of open-source firmware such as removing backdoors and bugs, improved user interface, functionality across brands and models, as well. With open-source firmware, the end user takes ownership of the source code empowering them to configure against security threats and control how long the code is as well as the boot process. Open-source firmware means the end user gains control over what is happening in their data center. Open-source firmware is headed in a healthy direction, and we predict increased adoption in 2022.

Our final prediction considers the million-dollar question, "What's next?" Today AI and 5G are two of the biggest trends that are on their way to revolutionizing the entire HPC industry. However, we do not see AI and 5G as two separate entities. We are still in the midst of a learning curve to understand the totality of the promise of AI and we are training our workforces to understand how machine learning and artificial intelligence can help us be more productive. But as time progresses, we see AI and 5G becoming one big topic. Why? Consider what it takes to power a smart city. How do you deploy the AI needed to power the city or autonomous vehicles and drones that will service it? 5G is the necessary component, locally, on the ground that will enable the data to move swiftly. 5G is the framework that supports and moves the massive amounts of data that AI needs to execute successfully. AI provides 5G with a purpose. And 5G is the engine that supports machine learning and AI functions. For now, we have AI and 5G - two separate entities that, we predict, will eventually merge into one. As one technology, who will be the winner?

Ionir (Kirby Wadsworth, CMO)

One of the biggest challenges DevOps engineers will continue to face is data gravity - the pull of the accumulating data black-hole and resulting lack of data mobility. This slow delivery of data is expected to double annually from now until 2024. Data gravity thwarts data movement, and our ability to keep up with dynamic customer demands, deploy applications seamlessly and produce efficient CI/CD pipelines.

Moving data is costly and wastes valuable time. Unlike transporting apps, in cloud environments transporting data takes hours or days, and can create massive egress charges. Data gravity threatens the entire value proposition of elasticity. It's harder to move the data required by applications than it is to move the actual applications.

In 2022, IT professionals will need to implement innovative data services solutions to combat data gravity and the disruption of DevOps pipelines. This is the final piece needed to achieve freedom from data gravity and see gains in reduced complexity, cost and management.

I predict we'll see a collective move to advanced container native storage that can eliminate data gravity by enabling instant movement of data to and from any cluster anywhere and providing instant access to any point in time. These solutions can offer data the freedom to move as fast and easily as applications.

iXsystems (Brett Davis, EVP)

Consumption of scale-out storage with both file and object capabilities will increase as more applications require

The flexibility of scale-out storage will underpin a growing number of storage deployments in 2022. First proven in larger environments, small and medium size enterprises have proven choices in scale-out storage that are both affordable and easier to manage. It's important that file or object workloads can be easily supported together as the needs of applications often change more quickly than the infrastructure.

Enterprise IT organizations will consider Open Source software-defined alternatives as they look to prepare for Web 3.0 and seek lower costs

The storage market is very mature, with ample choice among products that meet the most demanding requirements. Some features, such as corruption prevention, data/snapshot efficiency, and write persistence in the face of power outages and hardware failures, have traditionally been restricted to proprietary enterprise storage solutions that aim to lock customers into restrictive vendor ecosystems. Open enterprise storage software is dynamically changing this market by offering a true enterprise-grade storage experience for demanding applications at a lower cost up front and over time. Software technologies such as OpenZFS, Minio, Samba, Ceph, and HDFS are mature and empower choices that can dramatically lower storage costs.

The harmony of Kubernetes, GPUs, and scale-out storage will be a long-term trend to support AI applications

New workloads like AI require massive datasets, a high degree of parallelization, and high-performance compute and storage. The global enterprise Artificial Intelligence (AI) market is anticipated to grow at a Compound Annual Growth Rate (CAGR) of

39.7% to \$USD 309.6 billion by 2026. This requires scale-out computing and storage performance, GPUs, and much more storage capacity. No single vendor provides all the pieces today.

Komprise (Steve Pruchniewski, Director of Product Marketing)

Data mobility

Data mobility will play a larger role in enterprise digital transformation so that organizations can easily take advantage of multi-cloud and edge infrastructures and new tools for AI and ML. To be truly mobile, data should not only be able to reside in different systems across hybrid cloud environments but also natively access the services in those environments. The way data is used and accessed and its value changes over time. By future-proofing your data so you can move it to any storage whenever you want without penalty, and thereby adapt to change and new requirements. IT organizations have been focused in recent years on moving data to the cloud for cost efficiency and agility. While saving money is important, businesses want to make money with their data. Machine learning and data analytics is the next frontier. Data mobility is necessary for monetization of data through analytics and unstructured data management is an untapped area of innovation.

Unstructured data management and mobility will continue to be a hot market for venture capitalists

Data management is driven by very strong tailwinds that should continue to bolster its market growth. The explosion of unstructured data, growth of data at the edge and cloud, and the shift of data analytics to monetizing unstructured data are massive forces behind data management relevance in the market. Venture capitalists see the success of companies like Snowflake and Confluent and don't want to miss out on the next big data management and data mobility opportunity. How can you leverage these market trends to create a disproportionate advantage? A smart way to approach this is to look for a data management problem that you understand well, which hasn't yet been addressed by others, is pervasive in some market segments and is solvable. Hot areas include cloud data management, hybrid cloud storage, cloud monitoring and observability, cloud analytics, cloud security and unstructured data management.

Enterprises will want to capitalize on the venture capital money that is coming into the space to expand their capabilities, monetize the newfound capabilities that come with machine learning and unstructured data and ensure their workforces are diverse enough to not only reflect society as a whole but take advantage of burgeoning talent in sectors of society that in the past had been relatively untapped.

Data fabrics will be a strategic enterprise IT trend in 2022

The data fabric is still a vision. It recognizes that your data is living in a lot of places and a fabric can bridge the silos and deliver greater portability, visibility and governance. Data fabric research has typically focused on semi-structured and structured data. But 90 percent of the world's data now is unstructured (think videos, X-rays, genomics files, log files and sensor data) and with no defined schema. Data lakes and data analytics applications cannot readily access this dark data locked in files.

Data fabric technologies will be open and standards-based and bridge the unstructured data storage (file and object storage) and data analytics platforms (including data lakes, machine learning and natural language processors and image analytics). Analyzing unstructured data is pivotal because machine learning relies on unstructured data, therefore vendors need to incorporate unstructured data into their data fabric architectures. In 2022, the data fabric should move from being a vision to a set of architectural principles of data management.

Ransomware attacks object storage

As ransomware increases in sophistication, the massive amounts of data stored in object storage will be the next target. The rapid pace of object storage adoption is causing a skills gap with traditional IT teams who were well versed in securing and protecting file and block storage. Security vendors are warning that many buckets/containers have vulnerabilities such as open permissions.

The good news is that object storage supports immutability to prevent any alteration of data for a given retention period. Solutions such as AWS S3 Object Lock and Immutable storage for Azure Blob Storage provide protection against ransomware and even rogue admins.

As many file-based storage solutions use object storage as a tier, backup destination, or even primary storage in the case of cloud gateways, customers need to ensure they write data in native format to leverage immutability features which protect against ransomware.

It's likely that ransomware attacks against object storage have already occurred but have not been publicized. The year 2022 will bring the first high profile ransomware event on object storage.

Lenovo (Steve Biondi, Head of Channels and OEM, ISG)

The current global chip shortage and supply chain challenge will require businesses to be agile in doing more 'as-a-service' consumption. Most of our business partners are evolving to become MSPs to stay relevant for current and new customers.

The "LCaaS" hybrid model will become the preferred hybrid cloud approach, where some portion of workloads are offloaded into the public cloud space while keeping mission critical behind their own firewall. These workloads will then be managed either by the business, or outsourced to a local business partner.

Scott Tease, VP & GM of HPC

Sustainability will become a must-do for keeping up with customer expectations, and also a positive for a business' bottom line. More customers will include sustainability issues as core to their business decision-making process, such as selecting IT infrastructures with the lowest carbon emissions impact.

Much of the computing power needed in the coming years will be provided locally by dedicated HPC systems on premise but we will also see a large amount find its way to a public cloud .

Patrick Moakley, Director of Marketing HPC & AI

The continued pandemic will create a greater sense of urgency in bringing AI-enhanced solutions to production, particularly in conversational AI to aid in customer services.

AI deployment in more service-oriented industries will help companies cope with labor shortages throughout 2022, while maintaining positive customer experiences.

Metallic (David Ngo, Chief Technology Officer)

Enterprises were rapidly expanding their use of SaaS applications and other cloud services prior to the pandemic. However, the pandemic turned this wave into a tsunami, as enterprises suddenly found themselves using the cloud to digitize every business process they could, so it could be completed remotely and virtually, rather than on-site and in-person.

This rapid move to the cloud enabled enterprises to outsource development and maintenance of many of their core applications to SaaS providers, reduce on-premises infrastructure costs, easily spin up cloud-resources for the development of new applications, empower their employees to work from anywhere, and build stronger relationships with their customers through multiple digital channels.

However, not all is sunshine and roses in this new cloud dominated world. Enterprises now find themselves having to secure, protect, govern, optimize, and otherwise manage data stored in a dozen (or more) separate SaaS applications, multiple cloud services, on-premises infrastructure, and their remote employees' laptops. Everyday this data sprawl gets a little bigger, and while they can consolidate parts of it, they cannot eliminate it without moving back to the inflexible, expensive, and less scalable on-premises legacy systems of yesterday.

Many enterprises have taken some steps to use data security, protection, and other data management point solutions to gain some level of control over all this data sprawl. Yet without a comprehensive, unified view and control of all their data, this data sprawl will continue to expand out of their control.

The result? A massive data surface area ripe for cyberattacks. Poor data governance resulting in failure to comply with an increasing number of strict data privacy regulations. Fragmented data silos with multiple failure points, increasing the risk of data loss. Little to no automation of basic data administration processes. An inability to scale their data environment to support growth. Hurdles like these will slow the digital transformations that created this data sprawl in the first place.

Enterprises will seek to bring order to this growing chaos as they increasingly find data sprawl hindering their digital transformation efforts and even putting the integrity of their business data at risk of being locked, altered, or destroyed by cyberattacks or other disasters. Specifically, they will implement programs and solutions that allow them to comprehensively manage the storage, security, protection, governance, optimization and use of all of their data, whether it lives in a SaaS application, cloud service, on-premises or on an employee's laptop.

In 2022, those enterprises that succeed in gaining this type of control over data sprawl will be able to ensure the fundamental integrity of their business and accelerate their digital transformation efforts. Those that do not will find their data sprawl creating a gap between where their data environment is and where it needs to be if they hope to continue to grow in the digital economy and ensure the fundamental integrity of their business.

Growth of the Cloud Managed Services Market Will Accelerate

Over the past decade, and particularly over the last two years, enterprises of all types and sizes have adopted new SaaS and other cloud-based applications or moved their existing applications from on-premises infrastructure to the cloud. Recently, they have begun taking the next logical step in this journey - partnering with service providers to manage these SaaS and other cloud based applications for them, so they can focus on innovating on their own applications and on other priorities core to their business success.

Cloud Managed Service Providers (MSPs) have emerged to meet his need, helping these enterprises procure and use SaaS and other cloud technologies so they can concentrate on more strategic digital transformation and other business new objectives. By working with these cloud MSPs, enterprises can outsource previous in-house IT responsibilities - responsibilities like customizing off-the-SaaS applications for their particular business requirements, ensuring their SaaS applications comply with government data privacy regulations, and protecting their SaaS and other cloud-based data from malicious cyberattacks. Some enterprises are even contracting with cloud MSPs to help them with more strategic digital transformation initiatives, allowing them to speed up these initiatives and expand their development of unique cloud-based digital services that differentiate them from their competitors.

Enterprises have already rounded second base in their cloud journeys by outsourcing management of the infrastructure for their applications to SaaS and other public cloud service providers. In 2022, expect these enterprises to turn for home by partnering with cloud MSPs to help them manage the set-up, customization, and administration of their cloud-based applications -expanding revenue opportunities for IT service providers with the expertise, resources, and solution provider relationships required to deliver these types of cloud-based managed services.

MinIO (AB Periasamy, Founder and CEO)

Edge storage becomes a container play as it moves further and further out to accommodate the requirements of billions of sensors, 5G POPs and cameras

While the edge has two primary topologies, edge cache and edge storage - the growth will come in the latter. Edge storage increasingly demands containerization because it does not look like a mini data-center but rather a distributed system of endpoints.

To be successful in this model, everything needs to go into the container: application code, databases, even persistent storage. To fit in a container at the edge requires lightweight, powerful, resilient, secure software components. This is why MinIO is the object store of choice - it can run in a stateless container while ensuring the data retains state. If the container fails, the data remains safe in all but the most extreme examples of total loss.

Software defined storage gives way to container defined storage

Kubernetes has already won - this much we know. Since Kubernetes only knows how

to manage containers, not bare metal, not appliances this is where the world migrates to. Interestingly, this extends to services too. Only when EVERYTHING is software defined could virtualization be optimized. Only when EVERYTHING is containerized can Kubernetes be optimized.

This makes container-defined everything the trend to watch in 2022. For those organizations struggling to make the transition from appliances to software, the bridge to container defined may be too far.

Model9 (Gil Peleg, Founder and CEO)

Companies will adopt the “Data Fabric” concept to eliminate data silos, unify data and simplify data operations

Data fabric enables companies to integrate and share data across similar data sources, so they can access the data they need when they need it. In contrast to this principle, data silos keep the value of data locked away. Companies are now realizing this, and so they will move towards finding ways to make better use of their data and choose a simpler way to manage it.

One example would be replacing legacy backup and archive software with a more modern, cloud-based approach that liberates mission-critical mainframe data and makes it available for cloud tools to consume it and then unlock the insights it contains.

The cost and complexity of application migration and rehosting projects will drive customers to look for data-led approach to integrating core business apps and modern cloud apps

Traditional approaches to mainframe modernization which were characterized by moving applications from the mainframe en masse to other platforms has yielded limited success. Moving forward, a new alternative which involves moving data into the cloud and operating on it using “cloud smart” tools will be increasingly adopted.

The cost and proprietary nature of mainframe data processing will force companies to look for flexible and cloud-compatible solutions for data management

Although effective processes have existed for decades, as have applications that leverage mainframe data, it is increasingly hard to justify continuing on with the slow, complex, and difficult maintenance of the legacy mainframe tools they rely on. Instead, companies will generate new value by processing data from all of the new sources that have arisen over that time, which will need to be commingled with

mainframe data. Because that is more easily done in the cloud than on the mainframe itself, the focus will shift in that direction.

Nakivo (Sergei Serdyuk, VP of product management)

Organizations will adopt Intelligent security and increased visibility into threat landscape to combat cybercrime

Hackers are now tapping into advanced technologies in order to more easily penetrate businesses and keep up with corporations' increasing efforts to improve data protection. In response, in 2022 organizations will look into intelligent security technologies and capabilities enabling visibility into the threat landscape to identify new vulnerabilities to swiftly address them before disaster strikes.

Hybrid cloud to be the new normal

The hybrid cloud model, combining private and public cloud computing to enable greater flexibility, will see continued adoption in 2022. This relatively new trend of integration between on-premise and cloud environments is providing a new path for businesses that is both promising and daunting.

The new era of cloud integration has brought with it considerable management difficulties in balancing and integrating the new model and has proven to be a challenging task. Hybrid cloud also demands more comprehensive security administration to improve data protection policies and avoid potential breaches. However, with the strong drive to maintain business continuity, companies will aim to effectively address these challenges in 2022.

Organizations will better adapt to emerging data protection regulations

Due to new data protection and data privacy regulations being introduced globally, businesses will put processes in place to help them ensure compliance and better adapt to the fast-changing international data protection laws, such as the EU General Data Protection Regulation.

Nasuni (Russ Kennedy, Chief Product Officer)

Storage industry returns to pre-pandemic growth

After the months of upheaval, the storage industry is going to return to pre-pandemic growth rates, with cloud storage hitting double-digit annual growth rates. Generally, levels of data continue to grow, and companies need infrastructure and technology that can absorb, capture and utilize that data. However, areas such as on-premise storage hardware and traditional backup technologies will not grow quite as fast. Traditional storage and backup will not see higher growth rates due to “move to the cloud” initiatives in most organizations.

Ransomware will no longer be IT's little secret

Companies are getting smart about detecting and recovering from any attack: recovery cycles of weeks or even months are non-starters, because of the scale of lost productivity. However, even though ransomware attacks are common, they are often a cause of embarrassment, even shame, and so are hidden from public view. In 2022, we'll see companies working to remove the 'stigma' associated with such attacks, by safe proofing themselves and communicating to customers their policies and measures in place, as well as reinforcing best practices and employee education to protect themselves against this ongoing threat.

Having a CRO will become a necessity

We will see the rise of the CRO (Chief Recovery Officer) as an essential role within organizations, driving much-needed resilience in uncertain times. With the volume of cyber-attacks increasing and the scale of corporate file servers and data being compromised being much greater than is generally realised, the number of organizations needing to perform a full recovery will grow. An enterprise-wide recovery is a massive effort which can fall between gaps created by IT's siloed approach. Someone will need to rise to bring different departments together and drive coordinated action across different areas of the business. The CRO will need to ensure that restoration doesn't fall between the cracks and that the suggested best practices actually make recovery possible within minutes - otherwise they aren't really best practices.

NetApp (Matt Watts, Chief Technology Evangelist)

“Digital first” as new business paradigm

While IT teams and IT leaders are historically called on to drive digitization and increase value, the roles will be reversed in the post-pandemic world. Strategic decision making starts with digital experience and digital transformation since they

are now deeply connected to the successful operation of any company.

We see this for example in business analytics, where the analysis of user experience journeys or customer experience journeys become a crucial information source for strategic decisions.

Another example is increasing convergence between the online and offline world, which results in digital twin concepts being adopted beyond production, and any process being tested virtually before being considered for rollout.

Cyber security and resiliency

The pandemic months have triggered a rapid increase in ransomware attacks as more and more people worked remotely. Coincidentally, this opened up a multitude of new infection vectors.

Enterprises had to come to terms with the fact that many IT security processes and protocols are not well suited to the fight against ransomware, because it is virtually impossible to cut off all these infection routes, especially when criminals use social engineering.

Instead, enterprises will rely on AI-based prevention across their whole domain and stringent zero trust policies. Rather than preventing IT attacks from happening, this approach minimizes their impact. Once an infection happens, it is discovered almost instantaneously: Infected areas are cordoned off and infected files replaced in almost real-time.

Sustained impact of the pandemic: cloud acceleration and the supply chain

The global supply chain has been brought close to its breaking point by the COVID-19 pandemic and its impact on air, sea, and land travel. We predict that cloud adoption will accelerate faster as the supply chain constraints drive buyers to find alternatives to purchase traditional on-premise infrastructure to meet demands. At the same time, optimization of production lines and business processes can help the system to become more robust in the future. Marrying IT and Operational Technology (OT), for example through digital twin concepts and technology such as IIoT and analytics, has virtually limitless potential. Companies that have done their homework in the past, e.g. by building out flexible Industry 4.0 production facilities, will be able to stay healthy much more easily.

The workforce is going through a major change cycle, also triggered and sustained by the pandemic. Hybrid working environments are the expectation of employees moving forward. The ability to work anywhere will increase the digital capabilities businesses must provide to their staff. Controversially, the pandemic also shone the

light on labor shortages surfacing quickly and unexpectedly. This will be both a challenge and opportunity for high-skill sectors like the IT industry. On the one hand, there is bound to be fierce competition for skilled personnel; on the other hand, IT itself can deliver technologies that remedy the labor gap, such as low code, no code and AI software development.

The constant simplification of public services access and the services in general will drive broad buy in for digitization. People are also going to be more comfortable with providing their data because they have experienced the positive impact of virtualized service delivery.

Productized AI

In 2022, artificial intelligence (AI) will begin to permeate all industries. We will see it used in agriculture, food production, fast-food chains and the entertainment and hospitality sector. Agriculture and the food industry, for example, will use it for packing and processing, while other sectors gain most from general automation and the simplification of their processes.

Let's also talk about the "how." Managed services become a primary delivery mode for AI as CSPs double down on "GPU as a service"-type offerings. This is an important facilitator: As more industries use AI to stay competitive and innovate, there needs to be a solid technology foundation that can scale accordingly, and AI users need to move their AI projects from standalone (siloed) infrastructure onto shared, virtualized, production environments.

Another driver is "Tiny Machine Learning." Experts are forecasting a massive increase in AI at the edge, down to very low cost, extremely resource constrained edge devices. Think of sensors rather than compute devices. This is another generation of devices that feed the ever-growing edge-core-cloud data pipeline, which industries need to access and leverage to differentiate themselves.

And, finally, the macro perspective on AI and machine learning becomes clearer. Countries and governments are guaranteed to invest in AI and ML capabilities to accelerate economic transformation and compete on a global basis.

Data trends

There are a number of technology sub-trends that drive change and innovation. One is Analytics & Optimization of digital services. E.g., Finops results are much easier to come by as more automation and smarter applications take hold. This results in increased ROI from cloud investments throughout the public and private sector.

Another trend concerns production environments. There is a clear move away from

applications as companies deliver their services through containerized solutions and microservices.

Thirdly, data sharing regimes are important prerequisite for building a workable data economy on the international stage. GAIA-X sparked an important discussion about digital sovereignty and the contributions needed to establish a secure data exchange

infrastructure. In the near-term, I don't think this results in a sovereign "EU Cloud." However, we will see more unity about European norms, and more adherence to them from outside Europe.

Lastly, specifically in data storage, NAS and SAN continue to be the technologies of choice to underpin digital innovation. Writable storage media can still be made more efficient.

Quantum computing

Quantum computing is expected to re-accelerate the performance cycle postulated by Moore's law, and all major IT players are invested. Early use cases are expected to be delivered as a service but will not come into fruition for some time. However, manufacturers in different branches of IT will be more vocal about their quantum computing strategy in 2022 – for example security providers, hyperscalers, storage companies, and GSIs/global advisors. These manufacturers will also theorize how they can deliver quantum computing innovation as a service for their customers and overcome branch-specific limitations, e.g. building a data pipeline into the quantum computing cloud.

Sustainability – ESG becomes a competitive advantage

Green topics are on the rise, as demonstrated by the 2021 Climate Change Conference, the US infrastructure deal, or the traffic light coalition coming to power in Germany. We predict that businesses will head in the same direction. This is partly due to regulatory pressure, for example to lower carbon dioxide emissions. But enterprises will also become intrinsically motivated to deliver green innovation. One area to look at is employee experience hybrid models, which basically allow companies to recruit talent everywhere, reduce office footprint, and significantly cut work travel.

Another area concerns production processes, which can be made more environmentally-friendly with the help of IT. More automation and optimization, flexible production, testing and planning in software, are all things that reduce wastage.

Net Zero targets will become a priority for businesses in 2022, and they are impacting corporate decision-making already now. This will result in companies examining not just their own actions but their supply chain, digital and non-digital, as they strive to deliver net zero (carbon emissions) as quickly as possible.

Nutanix (Monica Kumar, SVP of Marketing and Cloud GTM)

The last two years have put significant pressure on organizations to quickly modernize their IT infrastructure to keep up with an ever-changing landscape. Cloud has indeed become a must have enabler of innovation. But more and more IT leaders are learning that cloud is no longer a destination but an operating model. So, what does this mean for the coming year? Here are some of my predictions for the year ahead.

IT Outlook: More Clouds in the Forecast

I expect the shift to the cloud to continue in full force, and CIOs everywhere will be redefining what that means, and putting it into action. In 2022 and beyond, moving to the cloud will likely mean something different for every organization, based on their business needs. For some, it will be going all-in with a specific public cloud vendor, but for many others it will mean broadening their mix of public and private cloud investments to best support each area of the business. For all, it will certainly mean embracing cloud principles, like agility, flexibility and automation, to create an IT environment that best works for them.

And while multi cloud is already established and the dominant IT model, we also know there are many challenges in managing a mixed, cloud environment. As IT leaders focus on building an IT operating model that best supports their organization, to better support a company's ever-changing needs, hybrid multi cloud will quickly rise to the surface as the ideal solution.

Redefining the CIO Role and Accelerating IT

The pandemic has also redefined the role of the CIO. If before they were often seen as running a "cost center," most organizations now recognize the CIO as a key role in enabling business strategy and operations as well as employee productivity.

In the year ahead, reimagining today's IT best practices and effectively implementing the cloud, will require a strategic vision centered around enabling business success. From developing a flexible app-centric approach to IT, to effectively supporting employees in whatever mode of work they prefer, CIOs will need to look beyond their existing policies and procedures and, once again, reinvent their playbook to best

support the business. Flexibility will be the center of a successful IT strategy and CIOs will need to build a cloud operating model capable of supporting that.

Solving the problem of hybrid data

Data proliferation is often discussed as a key issue, but we don't often talk about the challenges of managing data in multiple locations. However, this is the reality and we're not going back. So I expect 2022 to be the year we take important steps in addressing this issue, with both vendors and IT leaders working together with this common goal. From having visibility of all data regardless of location, to ensuring data protection and governance policies are applied uniformly regardless of which cloud the data resides in, to providing data security across clouds, to simplifying database management across multiple clouds, 2022 will be the year of hybrid data.

What is certain is that enterprises will require flexibility and IT will continue to be a key enabler in supporting that. The era of one size-or vendor-fits all is over, and success will hinge on being at the forefront of this trend.

Panasas (Todd Ruff, VP Marketing)

Security (i.e., protection from hackers) will intersect the HPC space—the ivory tower that protected HPC is finally crumbling.

“DPU”s (Super NICs) will start their explosion, freeing the CPU of infrastructure costs (e.g. from Zero Trust architectures).

COVID will continue to reshape customer relations, opening the door to other positive changes at smart organizations.

Point Software and Systems (Thomas Thalmann, CEO)

Object storage with integrated tiering and HSM functionality

Object storage systems based on more than one storage technology (e.g. HDD and tape) and integrating intelligent HSM functions will become interesting for use cases where huge amounts of object data have to be stored and kept for the long term. Internal tiering algorithms will ensure that objects are automatically moved and/or replicated between the different storage tiers.

Removable storage media against ransomware

Due to the increasing number of cybercrime attacks, off-line media providing a true "air gap" such as tape and optical, will gain in importance. The replication of productive on-line data to off-line media using appropriate replication software will provide an additional layer of protection to ensure recovery after a ransomware attack.

Hybrid cloud storage

Hybrid cloud storage combines the advantages of on-premises storage and cloud storage. A hybrid storage architecture will enable applications and data to interoperate between private and public cloud infrastructures, services, and instances.

Pure Storage (Ajay Singh, CPO)

5G Will Change the Public Cloud as We Know It

In 2022, there's still likely to be more hype around 5G than reality – at least to the naked eye. Under the hood, however, the new applications 5G will drive – from AR and VR to new drone capabilities, and more – will supercharge a dramatic shift in infrastructure demands. Eventually, we'll begin to see the emergence of an "edge - cloud" - edge computing delivered as a cloud-like service - and growing momentum around cloud native architectures to support innovative applications of 5G and ultimately a new set of customer demands.

The Modern CIO will Invest in Data

Building a flexible infrastructure and delivering agile applications is no longer a competitive advantage. In fact, it's the bare minimum that CIOs must invest in to keep the lights on and maintain reliable day-to-day business operations. The agility and intelligence needed to succeed in the modern era is truly about creating real-time actionable insights from data services - from machine learning/AI to as-a-service offerings, and more. The CIOs will place a heightened focus on deriving value from data to enable modern (and innovative) products, services, and customer experiences.

Environmental, Social, and Governance (ESG)

With increased global awareness around climate change there will be a bigger focus on carbon neutrality and sustainability in the future. Customers will also want their data centers and infrastructure to be more space, cooling and power efficient. As a result, they will apply stringent criteria when buying solutions and will demand systems that are more efficient, have denser capacity and produce a smaller

footprint. Their decision making will also be driven in part by a desire to have longevity from their investment, and also by supply chain constraints, which will lead to a reduced appetite to replace arrays or do forklift upgrades and refreshes.

Quantum (Tim Sherbak, Product Marketing Manager)

Large enterprises, cloud-scale solution providers, research facilities, and government agencies will increasingly turn to online, tape-based solutions for storage.

Emerging cold storage architectures and services will become more popular due to its high-performance access and simpler cost models.

Architectures based on RAIL (Redundant Array of Independent Libraries) will finally hit their stride in 2022 due to advances in multi-dimensional erasure coding technologies specifically optimized for tape library characteristics.

Diana Salazar, Product Marketing Manager

The focus of securing endpoints will shift to backup infrastructures and will be a key differentiator between those who pay ransom (and lose customer trust and revenue) and those who don't.

Offline storage, aka tape, will increase its presence in 2022 as a viable, cost-effective solution and pairing to cloud when leveraged on prem for ransomware recovery.

Companies will begin to utilize secondary storage tiers for unstructured data to enhance application performance and free up space in the primary storage tier, while still keeping the unstructured data protected and accessible.

Qumulo (Ben Gitenstein, VP of Products and Solutions)

With ransomware attacks at an all-time high, security solutions will evolve to be a no-brainer: simple and always on

In 2022, having a product that is simple to run in a secure fashion will be critical. Any well-developed application will put security at the forefront, so that enterprises can keep their data as secure as possible by default. Next year and beyond, security will be seen as a more proactive asset rather than a reactive one. In order to protect data

systems against malicious actors, we'll see more enterprises integrate data protection and backup within its cohesive IT infrastructure.

The data industry will see more customer demand for the “verticalization of cloud,” or vertical-specific cloud solutions

Customers want solutions, not technology. In other words, they want to buy “off the shelf” products instead of building blocks. As capabilities in the cloud continue to grow in 2022 and more data moves to the cloud, savvy cloud players will recognize the customer demand for vertical-specific solutions that fit the needs of their industry. Customers won't need to assemble a bunch of building blocks in order to have solutions that are uniquely valuable to their business, because verticalization will do that for them – and these may even evolve to something that's more customizable in the long term.

In 2022, cloud performance won't be sacrificed for cost

Cloud cost optimization continued to be a hot topic in 2021, and cloud adoption won't slow down in 2022. But even as organizations accelerate into the cloud, their budgets don't keep up – and customers are wary of the potential to rack up an unexpected bill. Cost will be a major concern for customers who want to embrace the benefits of cloud computing, but want to avoid the pitfalls of overpaying for cloud storage on providers like AWS. The path forward in 2022 will be to optimize cloud costs by evaluating both cost and performance. Instead of settling for hidden costs and complex pricing structures, cloud customers will get savvier about choosing affordable, high-performing solutions.

Scale Computing (Jeff Ready, CEO and co-founder)

Orchestrated edge systems will become a viable public cloud alternative

Public cloud services such as AWS, Azure and GCP have completely transformed how IT services are managed and delivered. As Scale Computing's founder Jeff Ready is fond of saying, “the cloud just means someone else's data center” and while the cloud certainly has its advantages, it's not without its shortcomings. Which is why we are poised to see new paradigms emerge by which businesses can essentially build their own systems with similar capabilities of public cloud infrastructure, but intended to be run at the edge of the network. By clustering together fleets of autonomously managed edge computing platforms and distributing them close to where users live, organizations will be able to benefit from cloud-like convenience without having to compromise on performance.

Edge computing will unite IT and OT to drive industrial transformation

Industries like manufacturing rely upon a variety of operational technologies (OT)

systems to monitor and control devices and workflows in their environment – everything from simple temperature sensors to advanced industrial control systems. As these old school industries begin to fully embrace IIoT devices, they must figure out how to leverage all of the data that these systems generate without burdening their existing networks. As Rob High of IBM noted in our recent Spiceworks video meetup, “most IoT equipment these days now includes some kind of general purpose computer embedded in the device itself - we’re seeing this with everything from cameras to industrial robots.” Edge computing enables data to be collected and processed closer to where it’s being generated so it can be immediately put to use. Scale Customers like Harrison Steel are using edge-based systems today on the factory floor, collecting data thousands of times per second to keep their precision machinery properly calibrated. We have no doubt that the coming year will see this trend accelerate further as other industries embrace edge systems so they can bridge the IT/OT gap.

Edge innovations such as zero touch provisioning will ease the IT staffing crisis

According to a recent Gartner report, businesses think that talent shortage is the biggest barrier to the adoption of 64% of new technologies, compared to just 4% in 2020. This means that in many cases, IT leaders hoping to deploy a new technology solution might choose to instead delay an important initiative until they have the requisite skilled IT resources in place. But what if you didn’t need to have dedicated IT staff at every remote or branch office location to keep the IT ship upright? Zero touch provisioning, which enables a centralized IT staff to remotely deploy and manage their edge-based systems from a single console, promises to be a game changer in enabling resource-strapped organizations to remotely administer their systems without having to hire additional specialized IT workers.

ScaleFlux (Hao Zhong, co-founder and CEO)

Computational Storage Becomes Commonplace

Over the past year Computational Storage has become the ultimate choice for enterprise organizations and in the cloud. And the more companies are developing relevant products around it the faster Computational Storage becomes adopted across a wide range of applications and industries. Computational Storage will reach the tipping point in the coming years due to its being so well positioned to help enterprise and edge infrastructure to accomplish more powerful data analytics at a lower cost.

Consolidation in the Chip Industry Will Sabotage Innovation

The reality is that due to years of aggressive M&A in the microchip industry there are

only a few companies left, Broadcom, Nvidia, Intel, AMD, and a few others. Consolidation has made that industry very small compared to what it used to be and is potentially killing further innovation. I predict the market will need more innovative start-ups to infuse the ecosystem.

IT Leaders with Cross-Domain Knowledge Become Indispensable

We will see more hardware and software co-design which will require IT leaders with cross-domain knowledge. Software-defined ruled the last decade leading to a trend of IT wanting to decouple software and hardware deployment. But this has slowed due to the pandemic, we just cannot have the luxury of doing everything software defined. That is why there will be increasing intelligence needed between IT infrastructure and the data center to work closely, requiring further optimization between hardware and software. IT leaders will need to know how to co-design, manage, and optimize this.

Edge Computing Will Grow

There will be an increase in demand for edge computing. This increase is being fed by the need to power a growing number of base stations, the fixed transceivers that serve as the main communication point for mobile technology as 5G (and even 6G) grow in popularity. Also, as the number of self-driving cars increases, so does the need for local storage, as well as growth in remote processing power in the car itself. Edge will lead infrastructure and even cloud growth in the coming year.

On-prem Storage Increases in Importance

As data grows--both in size and importance--on-premises storage use will expand in parallel, growing into indispensable infrastructure for a variety of reasons including, security, performance, regulation, cost, and latency. On-premises storage will serve all these critical needs, while the cold and warm storage move to cloud. And we will see continuous progress and innovation in the segment of on-prem computing and storage, as well as with innovation on the edge driven by the need for 5G base stations, autonomous driving, and its associated costs. It will be impossible to store all this data in the cloud.

Scality (Paul Speciale, CMO)

Increasingly sophisticated cyberattack solutions will be built directly into the design of storage solutions to counter the wave of zero day exploits and ransomware attacks

Cyber attacks, particularly ransomware, have reached record proportions. High value corporate data faces significant risk. Therefore, we expect commercial solutions will be designed with more sophisticated, integrated mechanisms for earlier detection, prevention and ultimately for recovery from attacks that delete, modify, or encrypt

stored data. Storage solutions will be combined with advanced application-level, server and network security mechanisms to provide corporations with end-to-end solutions against cyberattacks across their IT stacks.

Since threats continue to evolve, preventing ransomware attacks from occurring entirely will be a false expectation. IT managers will need to deploy solutions that can help detect and recover from these attacks earlier and more efficiently.

New object storage systems have taken data immutability to even higher levels by implementing object locking, along with data retention policies. These effectively render data impervious to deletion or modification for the specified period. We predict these solutions will continue to rise in sophistication and become available from vendors in 2022 and beyond.

AI/MLOPS will become a standard part of enterprise and midrange storage products, enabling more robust operations, reducing staffing cost and improving service

For several years, the data storage industry has recognized a need for increased automation in storage systems management. This need is amplified by data growth, and by predicted shortages in skilled human resources needed to manage these mountains of data. IDC has published reports for "the Future of Work" that provide ominous predictions that a lack of IT skills will affect over 90% of enterprises and will cost them over \$6.5 Trillion by 2025. Previous reports have predicted that storage administrators will have to manage 50 times more data in the next decade, but with only a 1.5X increase in the number of skilled personnel.

The integration of AI/MLOps into large-scale data storage offerings will increasingly emerge to help administrators offload and automate processes - and to find and reduce waste and increase overall storage management efficiency. MLOps can monitor and provide predictive analytics on common manual tasks such as capacity utilization, pending component failures and storage inefficiencies. These innovations wouldn't be possible without the application of ML techniques, and their ability to consume and "train" from extremely granular system logs and event data during real-time operations.

Technology and data sovereignty concerns in Europe, the U.S. and Japan will create an industry of local/regional/sovereign service providers

Global enterprises are growing increasingly concerned about their dependence on technology providers and cloud services based outside of their geographies. Since data is now a highly valued enterprise asset, there are unique considerations pertaining to independence of sovereign data - and we predict that this will result in the creation of new localized services to address those concerns.

With the steady march of cloud service providers, especially worldwide players such as AWS, Azure and GCP, it's no wonder that companies struggle to keep track of the location of their data and the status of their compliance with local data sovereignty regulations they are subject to. Outsourcing and delegating IT services to global cloud service providers for the sake of economics, agility and flexibility does not absolve them of their compliance obligations. Turning a blind eye to their data sovereignty issues is just not an option.

This ushers an industry of local/regional service providers offering sovereign cloud services to captive markets by ensuring the data stays with specified borders.

Seagate (Colin Presly, Office of the CTO)

Transitioning to post-quantum cryptography

The large investments in quantum computing technologies will likely result in computers powerful enough to weaken the security of classical cryptography. Current estimates are that this will happen sometime between 2026 and 2031. Going into 2022, a new class of cryptographic algorithms, known as post-quantum cryptography (PQC) is being developed and standardized to mitigate the potential threat of quantum computers. We expect the new PQC standards to be ready by 2024.

Distributed storage networks

The emergence of decentralized consensus protocols and distributed ledger technologies enables new ways of storing data in decentralized storage networks. These storage networks will become the foundation of the next generation world-wide-web known as Web 3.0. The amount of capacity within the decentralized storage (DeStor) networks keeps growing, with hundreds of petabytes being onboarded.

A broader adoption of object storage by enterprises

With the explosion of useful data, object store is becoming the standard for mass capacity because it offers advantages over traditional file stores including prescriptive metadata, scalability, and no hierarchical data structure. Storage systems benefit from greater intelligence incorporated in data sets and object stores provide this intelligence. Object storage's forte is new application development in combination with block storage to provide scale and performance in a symbiotic fashion. Many legacy file applications are also migrating to object storage infrastructure to take advantage of the economies of scale that object storage enables.

Cloud native software and app development is driving dynamically provisioned storage

The interoperability of the container deployment model promotes agility and flexibility for businesses, and, over time, facilitates the shift to multi cloud. Moving from manual to orchestrated storage provisioning enables better utilization of storage hardware while managing quality of service through storage class abstractions. The Container Storage Interface creates an extensible management plane for consumption of persistent volumes using a declarative method of control over standard and vendor unique storage features.

Fabrics will continue to be an important technology enabling disaggregated infrastructure

The interface unification and architecture simplification result in efficiencies and economy of scale. An example of recent innovation is the emergence of NVMe hard drives (demonstrated at OCP in November). CXL will allow for creation of fabrics of compute & memory.

SIOS Technology (Cassius Rhue, VP, Customer Experience)

While cloud computing will remain a core component of many an organization's IT strategy, 2022 will see many companies expanding beyond a single-cloud strategy. Not surprisingly, companies making a first foray into the cloud have tended to standardize on a single cloud vendor. Amazon Web Services Elastic Cloud (AWS EC2) has maintained a first-to-market leadership position in the world of infrastructure as a service (IaaS), taking in 31% of the worldwide cloud infrastructure spend in Q2 of 2021. Organizations that were predisposed to Microsoft have generally gravitated to Azure, which took in 22% of the worldwide cloud infrastructure spend in 2021. Google Cloud Platform (GCP) took in 8% of the worldwide cloud infrastructure revenue, but in 2022 we predict a greater adoption of GCP in two particular use cases: With more cloud experience, companies running on AWS and Azure will expand beyond single-cloud standardization and increasingly add Google to their cloud computing mix in order to take advantage of Google's leading AI, ML, and complex analytics tools. Furthermore, companies looking for cloud-based disaster recovery (DR) options will consider enhancing their DR protection for their cloud-based high availability (HA) configurations by replicating to a different cloud.

Overcoming the challenges of multi-cloud for application specialization

Many companies have found themselves accidental adopters of multi-cloud strategies. In some cases, a multi-cloud strategy is the by-product of growth through acquisition. In others, independent decisions were made in decentralized IT departments and suddenly applications were running in different clouds to take

advantage of cloud vendor-specific features. GCP, for example, offers features that favor analytics workloads so it made sense to run those workloads there. But in both cases the experience has also been enlightening: Organizations are learning that a multi-cloud approach creates new options: They can choose different cloud offerings to meet individual application needs, operational demands, and high availability requirements.

Regardless of whether multi-cloud is deliberate or accidental, IT teams want to protect applications from downtime and data loss without adding complexity. While AWS, Azure, and GCP all provide high availability (HA) for their infrastructure - meaning that they will guarantee a service level agreement (SLA) of 99.94% uptime for their virtual machines (VM) - they do not guarantee application-level HA. That means that a VM could technically be up and SLA-compliant but the organization may be unable to run their critical applications. In several cases, human error has disrupted service to applications in cloud environments, even when cluster nodes were located in different availability zones (AZs).

To overcome this vulnerability, organizations have been adopting a strategy of choosing an HA vendor that can not only ensure proper application and data replication within a cloud but also one that can provide HA and DR solutions capable of supporting all the use cases required. That is, they can automatically replicate applications and data from Windows and Linux OS systems running on AWS, Azure, and GCP.

For organizations that simply cannot afford to have their critical applications and data go offline in the event of a whole-cloud failure or regional disaster, a multi-cloud DR solution makes sense.

Overcoming the challenges of multi-cloud for DR

Given the expense and the complexity of building out a multi-cloud DR solution, organizations will be selective about the applications and data they support with a multi-cloud DR solution. They will try to provision a DR infrastructure that mirrors - as closely as possible - the primary cloud infrastructure supporting their critical applications and data. The challenge for most companies will actually lie in the selection and configuration of the DR services that will keep the two cloud infrastructures synchronized and that will facilitate failover between the cloud environments if a disaster takes down or threatens the primary cloud environment.

Rather than relying on backups or log-shipping approaches for a DR solution - which would require IT to source and configure replacement servers before restoring lost applications and databases - organizations will configure a DR solution that can replicate critical applications and data across cloud infrastructures. In the event of a

whole cloud catastrophe, they will have a replicated copy of critical application(s) and data in a different cloud DR.

Some companies will choose to configure a multi-cloud DR solution in the same region that houses their primary cloud infrastructure, potentially enabling the organization to use a DR solution's high speed synchronous file transfer services to replicate data from one cloud to the other. More likely, given the possibility of slower inter-cloud communications, the DR solution will be configured to use asynchronous data transfers to replicate production data to the secondary cloud infrastructure. Asynchronous data replication will be slower than synchronous data replication and possibly create a situation in which the data in the DR cloud is a few seconds out of sync with the data in the production cloud, but that risk will be weighed against the added benefit of building out DR infrastructure in a geographically distinct region: This approach will ensure that whatever brings down the primary cloud infrastructure - particularly if the disaster has its roots in a regional event - will not also bring down the secondary cloud infrastructure they'd been banking on using in an emergency.

SoftIron (Phil Straw, CEO)

Rapid Expansion in Sovereign and Industry Cloud Provision

This expansion will be fuelled by a combination of

- A dissatisfaction with the dominance of a small number of public cloud providers
- The opaque nature by which many of these services operate
- Concerns over national security/ hardware/ data comprise
- Desire to build more home grown resilience in IT skills and infrastructure

The general availability and/or regulatory requirement to use specific clouds for specific use cases/ workloads will, we predict, be the catalyst required to drive innovation in making multi-cloud a reality

Further decentralization of On-prem infrastructure to the Edge - workloads transition from pilots to full scale rollouts

- Edge computing moves from pilot/ proof of concept/ early adoption phases into larger scale rollouts
- Driven by need to provide high performance , low latency compute & storage close to point of use - with by applications like ML and AI or as a result of an increasingly decentralized workforce.

Fuelled by growth at the edge, “hard-tech” startups become more commonplace in data center architectures

- Growing realization that the next generations of IT infrastructure problem (esp. at the edge) are best solved by innovation in both hardware and software - and adoption of the latest manufacturing technologies makes that possible efficiently/ profitability. An emerging trend being called “hardtech”. “If software eats the world, then hardtech gives it teeth”

StorCentric (Surya Varanasi, CTO)

In 2022, digital transformation strategies will enable organizations to store, manage and protect data at scale

Massive data growth combined with significant changes in the way we work today and a rapid rise in cybercrime has driven increased challenges for data center managers. In 2022, it will be critical to respond to these demands, and to pursue and achieve digital transformation strategies that enable organizations to store, manage and protect data at scale. And I predict that in 2022, data center managers will find that the ideal way to do this will be to start with the right data storage foundation.

In 2022, organizations will seek a data storage foundation that enables them to support a mix of workloads

The storage will allow for flexible configurations and simplified expansion to meet a wide variety of capacity and performance requirements. Next, organizations will seek a solution that provides multi-protocol support. Certainly, at a minimum, the storage will support block (iSCSI, FC) and file (NFS, CIFS/SMB). However, given the increasing desire to run cloud-native applications, backup and restore critical data, as well as archive data in the cloud, S3 object storage support will become a must-have as well.

In 2022, data protection and business continuity will be at the top of the list of digital transformation strategy considerations

In 2022, data center managers will not only be concerned with equipment malfunction, but also insider threats and external cybercriminal activity, such as ransomware attacks. So, capabilities such as immutable volume and file system snapshots that deliver secure point-in-time copies; object locking for bucket or object-level protection for specified retention periods; and pool-scrubbing to detect and remediate bit rot and data corruption will be deemed essential.

JG Heithcock, GM, Retrospect a StorCentric company

In 2022, with ransomware continuing to grow as a threat, data protection will become the most indispensable component of every organization’ digital

transformation strategy

Today, more than ever, data can be lost by accident, damaged by a natural disaster, or fall victim to cybercrime.

In 2022, the 3-2-1 backup rule will continue to be the golden rule of complete data protection

This means that organizations will keep three copies of data saved across at least two media types, with one more copy saved offsite. In 2022, ROI will also remain the name of the game, so organizations will seek a proven solution that makes this easy and affordable to implement. The ideal backup solution will enable a backup script to a local destination and a backup transfer script to an offsite target. Using a transfer script to copy backups to a second location enables the administrator to perform the operation offline, without the original source needing to be used.

In 2022, there will be various options available for implementing 3-2-1 workflows

The options include, 1.) disk and cloud – i.e., combining local disks and cloud storage locations; 2.) network-attached storage (NAS) and cloud – i.e., onsite NAS and offsite cloud; and 3.) disk and tape – i.e., local disk and a tape library for offsite storage.

In 2022, going beyond the 3-2-1 backup rule will provide organizations with extra insurance to protect their digital transformation initiatives

Organizations can choose to utilize a second cloud storage location (i.e., 3-2-2 strategy) or NAS, tape and/or cloud (i.e., 3-3-2 strategy) for added redundancy.

In 2022, utilizing WORM storage in the cloud with immutable backups will provide the best protection against ransomware attacks

With a locked backup, malware cannot delete your critical data, enabling the administrator to recover if the worst does happen. By combining the 3-2-1 backup with immutable backups in the cloud, administrators can ensure their organization's data is protected against the latest threat landscape.

StorMagic (Bruce Kornfeld, Chief Product and Marketing Officer)

DPU/GPU (e.g. smartNICs and other small compute platforms) will be more prevalent on the edge

As more analytics and AI is being performed outside the datacenter and cloud, we'll see these super-fast performance boosting technologies being deployed in edge servers.

Data analytics scales at the edge to reduce data or perform data thinning so that analytics software can provide better insights and value to an organizations' management team.

New data management approaches needed at the edge

There is too much data now being generated outside the datacenter and cloud (Gartner says by 2025 it will be 75%). Today's edge computing platforms weren't designed to handle this, therefore a new approach is needed to store the data cost effectively – "thin" the data by finding only the useful parts and then making it easy for analytics, machine learning and AI to extract value for organizations.

StorONE (Gal Naor, CEO and Co-Founder)

Minimum Price Per IOPS and TB – In 2022 and beyond, the price of storage solutions will be of high importance in general, and specifically, the cost of cloud-based solutions

As inflation rises, enterprise storage users will need to reduce expenses. In addition, cloud storage pricing has increased dramatically compared to on-premises solutions. 90% of spec utilization - The only way to substantially reduce the cost of storage is by taking advantage of more efficient software that extracts significantly more performance and capacity utilization. Storage software that achieves 90% capacity and performance utilization dramatically lowers the hardware requirement for all use cases. The same is valid for cloud installations, as using fewer drives and lower-priced compute instances will significantly reduce the overall cost of the solution.

"Five-Star Safety" rating will be the deciding factor for most storage purchases and any new storage system will have to meet the highest data protection standards

Concerns over suffering data loss in general and Ransomware, in particular, will cause customers to demand superior data protection capabilities. Five Star Safety has become mandatory when purchasing cars, so it will also be in the storage industry. In 2022, data protection will become an even more crucial issue when purchasing a storage system, and customers will demand superior solutions. Customers will demand integrated and comprehensive data solutions include storage's "Five-Star safety":

- Data Integrity – Direct write to drive
- Data Protection - Any amount of drives failure per volume
- Data Retention - Immutable and unlimited snapshots
- Data Replication - Multi site replication
- Data Encryption - Volume level encryption

Complete Hardware Flexibility – Analysts expect 2021’s hardware shortage to worsen during the first six months of 2022

These shortages will dramatically affect pricing and delivery times and it also highlights the difficulties with depending on pinpointed hardware solutions. More than that, customers want the ability to mix and match drives of different sizes and manufacturers on the same volume.

In addition, the exponential increase in the amount of data stored makes migrations an impossible task, further exacerbating the need for flexibility. A system that does not require migrations to replace the drives or controllers is essential in 2022 (similar to VMware solutions and any smartphone replacement).

100% software-based solutions that are hardware-agnostic provide the ability to mix drive types at the same volume and to use the same drives for all protocols without adding new storage systems.

Use of auto-tiering technology that can combine two types of drives - Flash and HDD - in the same volume and providing a more effective total cost of ownership.

StorPool Storage (Boyan Ivanov, CEO and co-founder)

Hybrid capabilities become crucial going forward

Due to mixed environments and new workloads, storage complexity is increasing, not decreasing. So agility, portability, and well-documented APIs are now prime considerations when designing cloud-native applications.

These applications should run on-premises and off-premises in the same manner but on different hardware and software stacks. So agility, flexibility, versatility, integrations and APIs become key KPIs of a storage solution, along with performance (think latency, IOPS, GB/S) and TCO (think Total Cost of Ownership, \$/GB).

Traditional SAN products/platforms become obsolete

The above-mentioned use case diversity from emerging applications puts strain on traditional, legacy SAN products and platforms. The storage solutions of two- and three-letter vendors have been largely unchanged for the last three decades, except for the introduction of faster storage media (SSDs/NVMes) and extra “data management” software pieces (“AI”, anyone?) on top of the same underlying rigid architecture.

Yet the large-scale, complex, and versatile IT platforms that power businesses today need a new generation of powerful and versatile storage platforms. These storage platforms can cover multiple use-cases, performance tiers, have API-first management, and linearly scale to sizes which were impossible with the traditional SAN architecture. Besides: who wants to buy and manage five different types of SAN/AFA family groups if they can have one or two best-in-class, latest generation storage solutions like StorPool for block and VAST Data/WekaIO for object/file?

Shift to software-first accelerates

The commoditization of IT started with the adoption of commodity hardware and open source technologies like Linux & KVM in hyperscalers. It is increasingly pervasive and leading to the commoditizing of the storage industry. We are seeing the emergence of Software-Defined Storage and Software-Defined Networking (among many other things), which have now become the default technologies to use in greenfield projects or refresh scenarios.

The tipping point is now reached, which will lead to a decline of traditional storage product revenue in favor of latest-generation, software-centric storage technologies.

Usage based pricing

When StorPool started offering pay-per-use pricing in 2015, we were one of the first (if not the first) on-prem storage vendors to bill only for what you use. Now several vendors offer such STaaS (Storage as a service) type of licensing. In our view, from 2022 and onward, this type of pricing will be overtaking traditional models, like pre-paying a specific set capacity on a CAPEX/perpetual license basis.

StrongBox Data Solutions (Andrew Hall, CEO)

AI Will Play a Significant Role in Protecting an Organization's Data from Ransomware

According to recent studies, 37 percent of organizations were victimized by ransomware in 2020, and the number of affected companies will continue to grow. Our national and world economies have become dependent on access to digital information. The increasing use and acceptance of cryptocurrencies, IoT, physical supply chain, NFTs and digital supply chain, and other emerging digital technologies will cause a rising security risk for all types of environments, including on-premise, cloud, and hybrid. As a result, there will be an increased emphasis on how to best protect organizations and sensitive data, plus prevent serious impact to businesses and the customers they serve.

No single magic bullet will resolve all threats, but a well-thought-out strategy on how to protect the organization's lifeblood will continue to be paramount. Over the next year, artificial intelligence (AI) will begin to play a more significant role. AI applied to data management will enable an organization to identify what files are important and impactful to the organization and classify them into areas such as: "critical," "severe," "impactful," "limited impact," and "not relevant." The ability to intelligently act on this classification to continually protect data and quickly – if not immediately – recover from incidents will be critical to reducing the negative financial and human impact on employees, customers, and vendors. Data management AI will become a regular part of an organization's technology investment to thrive in this rapidly evolving environment.

Metadata is the Key to Future-Proofing Data

Data is growing at an unprecedented rate, and most organizations are moving away from storage-centric solutions to hybrid solutions. With that shift, it's more important than ever to leverage the power of metadata. Properly implemented, metadata acts as a roadmap to give organizations the insights needed to control all of their data and storage resources. In hybrid environments and cloud environments, metadata can be used to help better manage "paradigm swings," improve the organization's data resilience, and reduce egress charges by targeting specific files. In 2022, organizations will increasingly leverage the power of metadata to future-proof their data and enable intelligence and unified data management across storage types from different vendors.

Federated Global Namespaces to Rise in Importance as Organizations Adopt Hybrid and Distributed Environments

A global namespace (GNS) is essential for simplifying storage management and identifying multiple network-based file systems. A global namespace provides a unified view of data distributed across multiple file storage systems, allowing users to access and file data anywhere, regardless of physical location. When this system becomes federated, more than one previously distinct and disconnected storage management system can interoperate and benefit from truly synchronized data management on a global geographical scale. Over the next year, this will become essential as organizations continue to adopt hybrid and distributed environments. In addition, GNS will become increasingly important as organizations attempt to reorganize their IT, network, and storage environments to align with new needs and expectations to excel in this "new normal."

Tintri (Phil Trickovic, SVP of Revenue)

It's not new news. Exponential data creation and manipulation continue by the microsecond. The accelerant fueling the shift? New methodologies bring new efficiencies and reduce costs, while improving application lifecycles, thus exposing a global digital transformation at a scale and speed never before witnessed.

There is a surge of growth in all aspects of modern application stacks. This growth is fueled in part by advancements in data collection, analysis, and AI operations, in addition to unexpected advancements in processing architectures. We can do far more with far less. But how?

Following are our compiled views with input from our customers and partners. We have uncovered many interesting shifts in the industry for 2022:

Customer Pain Points Require Timely Solutions

While 2021 pushed us out of the office and into new environments, the next year(s) will have us maintaining them as we navigate this "new normal" work environment. Throughout this unlikely turn of events, COVID has shined a light on IT infrastructure needs that require quick-recovery solutions. Looking ahead to 2022, IT administrators will have to find the right solutions to address new and growing pain points in IT support.

Taking advantage of the economic instability created over the past year, ransomware attacks will continue to be a thorn in the side of already vulnerable businesses. As we move forward into the next year, preventing these attacks will require fast, intelligent solutions for prevention and recovery. Tintri's new host of snapshot capabilities helps detect anomalies and prevent ransomware attacks, as well as quickly recover ransomed data. By educating users on how to utilize their analytic capabilities and virtualize their vulnerable applications, ransomware attacks can be snuffed out before any damage is done.

Virtual Desktop Infrastructure use cases are also continuing to grow, as the pandemic keeps us all in hybrid spaces. As work-from-home becomes more permanent, maintenance will require quick turnaround in IT support. Overwhelmed by a wave of quick deployment, IT resources are already stretched thin. The resources required to continue to maintain these environments are going to be more crucial than ever, as we strive to prevent latency and maximize efficiency.

Doing More with Less - Virtualizing Workloads to Meet Modern Standards

Pandemic IT needs have pushed administrators to update to modern standards. The pressing need to transfer our workloads online revealed the shortcomings that COVID exposed with traditional applications, highlighting the requirement for more cost-effective workload intelligence. Shifting toward microservices and AIOps will help

automate workloads and take the weight off administrators focusing on maintaining the WFH environment.

While automation can never totally replace the storage administrator, AIOps can improve the efficiency of storage teams and free up individuals to focus on more valuable tasks like working with the business on future requirements. Investing in AIOps will offer users real-time processing to create new data sources and metrics, as well as Domain Algorithms that will aid in workload automation. Furthermore, automated workloads are causing massive shifts toward VMware platforms leading to extensive savings and increased performance.

Tintri Gets Personal

This past year, Tintri has taken strides to invest in relationships with our partners and customers. Engaging with customers will continue to help them adapt to the future of emerging technology. Taking deliberate steps to connect more personally with customers and partners, focusing on their needs, can position storage providers exactly where we're most valuable.

Tintri, for example, is situating itself right where customers will benefit: focusing on a coming wave in the Container/Kubernetes workflow and in microservice architectures. We seek to help customers adapt to advanced workflow demands. Investing in AIOps integration can greatly simplify Kubernetes deployment, and adjusting advanced workflow analytics will help AI and HPC data lake deployments going forward.

Tintri will bring the same functions and features from existing microservices to containerized applications. We will also be improving and enhancing our existing AI and machine learning capabilities. Microservices greatly reduce operational costs once deployed. We are all in on microservices to better benefit the customer.

We've learned here at Tintri that a creative, personal touch helped improve customer relationships moving out of the pandemic. Investing in people shows that you're more than a business, and communicating that there are people behind the brand builds trust when it's most needed. Tintri is built from the ground up for virtual workloads. We will continue on that path.

Toshiba Electronics Europe (Rainer Kaese, Senior Manager Business Development, Storage Products Division)

As yet SSDs are certainly not defeating HDDs, nor are they expected to for many years to come

HDDs will remain relevant within key target markets in the long term. They have a vital role to play in ever-expanding online storage implementations, as well as NAS, internal drives for surveillance system NVRs, external USB drives for low-cost PCs, gaming system back-ups, etc.

Engineering advances are helping to maintain HDDs as an attractive option

Toshiba 18TB HDDs using flux-control microwave-assisted magnetic recording (FC-MAMR) technology are a high-profile example of this. Here a microwave generating element is used to control and bundle the magnetic flux. Progress in relation to this technology is continuing, with scope for smaller magnetic areas per bit to be achieved - resulting in even higher densities, more platters and a larger overall magnetic surface. It will soon bring +20TB capacities to single HDD units.

Shingled magnetic recording (SMR) technology is here to stay

Though having been questioned in the past, SMR technology is now widely accepted in client drives, since the benefits it brings in terms of doubling the storage capacity on the same physical resource are very compelling. Also, it is clear that the smart cache/buffering architecture more than adequately compensates for the performance degradation in nearly all real-life workloads.

Tiering will provide a highly effective way of optimizing storage resources

Here creation, manipulation or analysis will be done using small and fast SSDs, while the to be analyzed, manipulated, or generated patterns will be stored on in-expensive 2nd tier HDDs. This approach will be applicable to a variety of different applications.

Backup storage for the consumer sector is another important trend

For those that do not choose cloud-based data storage, or like to combine it, external HDDs free up space on mobile devices and PCs, thereby helping to extend their performance. Whether it is for backing up home office projects or for photo archives, external storage solutions like Toshiba's Canvio Flex provide an extensive array of connectivity options via which safely stored data can be retrieved rapidly.

Unitrends & Spanning (Joe Noonan, Product Executive, Backup & DR)

With cybercrime on the rise, backup and disaster recovery has taken center stage and will continue to do so in 2022. Having a unified business continuity and disaster recovery (BCDR) strategy is not a luxury, but rather a necessity. Companies will need to evolve their plans if they want to protect their data in 2022 and will need to

become adept at planning for cybersecurity threats, leveraging cloud solutions, testing more frequently and adapting to the tech talent landscape.

Plan for more cybersecurity threats

Thanks to the growing number of cybersecurity threats, organizations must assess their environment more thoroughly to ensure they have a complete BCDR strategy-especially when it comes to the recovery process, which has become more complex. Companies need to look at technologies that are easy to set up, cost-effective and incorporate automation in strategic ways-for example, organizations should assess solutions that automatically identify common issues in the production environment that are tell-tale signs of a ransomware attack. Cybercriminals will continue to evolve their tactics, so businesses need to allocate their IT budgets strategically to invest in the most effective BCDR technologies.

Additionally, companies should be aware of their cyber insurance policy's requirements around backup to address the new cyberthreat landscape. Organizations should expect conditions requiring two-factor authentication in their environment as well as requirements for audits and scans after cyberattacks that may increase recovery times in certain situations.

Leverage cloud solutions

One of the biggest misconceptions businesses still have about BCDR is the security of the cloud. Using the cloud as part of your strategy can add more resilience, as organizations can utilize immutable offsite storage and disaster recovery as a service (DRaaS) to ensure recoverability and eliminate downtime in the event of a cyberattack. When assessing cloud storage options, it's crucial to consider compliance and security requirements as well as technician bandwidth to manage and maintain key systems.

Schedule more testing

Though companies often conduct quarterly testing, that schedule is too infrequent-especially with the growing number of cyberthreats in 2022. A lot can happen over a three-month period, and the strategy will be hard to execute if it hasn't been exercised. Once a month, and even weekly testing for critical machines, is an important best practice that companies should prioritize in the year ahead. To relieve technicians from manually testing each machine, organizations should utilize solutions that provide automated testing that can be adjusted based on the workload being protected. Often, IT professionals assume that if a machine can be booted and data can be accessed that a recovery is successful. However, they need to test how applications are running by doing service checks as well as testing transactions in certain cases.

Expect competition for tech talent

Finally, in 2022, there will continue to be heavy competition for tech talent. As IT

professionals move between jobs, companies are at risk of losing knowledge with their departure-including critical information around the organization's BCDR strategy. To avoid any knowledge gaps, it's critical for IT professionals to document everything, automate as much as possible and even leverage managed service providers for additional assistance.

The upcoming year will require companies to be more intentional about their BCDR strategies. The cybercrime landscape will continue to force organizations to be creative in their approaches and constantly evolve their plans to keep pace. Businesses will need to leverage cloud solutions and increase the frequency of their testing to be fully prepared for a data loss event. These days, part of the strategy is accepting that it's not a matter of if, but when, and preparation is key.

Veeam (Danny Allan, CTO)

2020 had a drastic impact around the globe, and 2021 has reflected the aftermath. As we look towards the new year and begin to ask ourselves, "what's next?", looking back on the past two years will play a huge role in what's impending. As 2022 approaches, we will begin to see how the surge of new technology tools will undoubtedly mark a new era in cloud, AI and automation dependency. On top of this, we will see how the Great Resignation continues to impact the tech labor shortage and how companies adapt to it.

AI and automation will replace entry level jobs in the finance, healthcare, legal and software industries

The talent shortage will leave many jobs unfilled, making way for the advancement of artificial intelligence and automation to fill new roles. We have seen technology begin its takeover in the service industry with the introduction of robotic waiters during the pandemic. In 2022, we will see AI and automation capable of filling positions in other hard-hit sectors like the finance, healthcare, legal and software industries. These developments will mostly affect entry level positions, like interns, making it harder for recent graduates entering the workforce to gain job experience in the future.

CI/CD will stabilize and standardize to become an IT team requirement

The Bill Gates memo in 2001 became the industry standard in how to design, develop and deliver complex software systems - and today it feels like there has been no standard since then. IT teams and developers fell into habits of adopting "known" technology systems, and not standardizing in new spaces, like continuous integration and continuous delivery (CI/CD). In 2022, we're going to see a shift towards more stability and standardization for CI/CD. IT leaders have an opportunity to capitalize on

this high-growth and high-valuation market to increase deployment activity and solve the "day two operations problem."

New privacy-focused legislation will shift attention to data sovereignty clouds

With increased focus on General Data Protection Regulation (GDPR) regulating data protection and privacy in the EU and the California Consumer Privacy Act (CCPA) enhancing privacy rights and consumer protection for Californians, other states and countries are facing pressure to enact comprehensive data privacy legislation. As this continues in 2022, I expect we'll see much more focus on data sovereignty clouds to keep data within nations or within a certain physical location. This is a far more specified cloud model that we're starting to see in EMEA with Gaia-X. Some will see this as an obstacle, but once implemented, this will be a good thing as it puts consumer privacy at the core of business strategy.

Containers will become mainstream to support the cloud explosion of 2021

Businesses wrongly predicted that employees would return to the office, as normal, in 2021. Instead, remote working continued, and companies were forced to develop long-term remote working strategies to ensure efficiency, sustainability and to retain employees seeking flexibility. This remote work strategy demanded cloud-based solutions, resulting in an explosion of cloud service adoption. To meet this moment, containers will become mainstream in 2022, making the generational shift to cloud much easier and more streamlined for organizations.

Tech's labor market will be met with big money and big challenges

The COVID-19 economy - and the subsequent great resignation - throughout the last two years certainly made its mark in the tech industry. As we continue to see turnover and lower employee retention, tech salaries will begin to grow in 2022 to incentivize talent to stay. I see this causing an interesting dynamic, presenting bigger challenges, especially to the folks in the startup and VC world. The bigger tech giants are the ones who can meet the high dollar demand and deliver benefits for a competitive workforce. It will be interesting to see in the years ahead what this does for innovation, which tends to come from the hungry startups where people work for very little for a long time. We could very well see a resurgence of tech talent returning to the "old guard" companies to meet their needs for stable (and large) salaries, forgoing the competitive, hard knocks of startups that could cause a skills and talent gap that lasts for years to come.

While COVID-19 has had some disastrous implications around the globe, it has propelled forward a new world that is heavily tech reliant and defined. Remote work, severe labor shortage, a sudden worldwide demand for elevated technology and consequential cyber threats have forged a space where tech is king. 2022 will see major expansion and regulation of cloud, data privacy, automation and CI/CD, and a

subsequential high demand for talent and investment in the tech industry, shaping the future of the economy and workforce for the next decade, and maybe beyond.

Veritas Technologies (Deepak Mohan, EVP Products)

Businesses will rebalance the hybrid cloud

The pandemic boosted cloud adoption in an unprecedented way, with 89% of respondents to a recent Veritas survey stating that they had accelerated the journey to the cloud over the last 18 months. However, having made rapid decisions about what data to host where, many businesses are now ready to make longer-term strategic decisions about what their hybrid cloud will look like. Balancing the cost of different public cloud services against both convenience, and the SLAs they require, will be a challenge that many businesses will grapple with in 2022. Add to this the need to factor in ransomware resilience and it's clear that balancing the mix of physical, virtual and multi-cloud will be a highly nuanced decision.

AI/ML will drive the next wave ransomware – and its protection

Over the past year, ransomware attacks have increased dramatically across all industry sectors and hackers continue to get savvier. In 2022, we expect AI-powered security and data protection to take center stage for both hackers and the businesses that work to keep them at bay. As hackers introduce threats that can automatically adapt to avoid detection, organizations will respond by using AI and ML technology to secure infrastructures and protect data with tools that are continually learning and improving all on their own - much faster than humans could hope to update them.

Containerization will start to take flight in mainstream production environments

The entire world is starting to shift its attention to Kubernetes and the orchestration of containers and 2022 will be the year where we really start to see serious deployments in production environments. Just as we went from physical to virtual to cloud, we're now ready to make the next step and go to microservices and containers. This will allow businesses to really achieve the benefits that they were promised when they moved to the cloud. Enterprises with diverse applications or large and complex IT infrastructures will be able to realize the scalability and elasticity of the cloud to drive cost savings, as well as freedom of movement – from on-premises to the cloud and from cloud to cloud. We're already starting to see some of the biggest cloud providers offer turnkey Kubernetes solutions, as containers enable ease of data portability and, in 2022, we're expecting greater

adoption of these by enterprises around the world. For all these reasons, in the new year, it will be all about Kubernetes.

Viking Enterprise Solutions, Sanmina (Odie Killen, VP of Server & Storage Engineering)

Adoption of SAS-4 storage protocols will occur faster than initially expected

Due to increased availability of SAS-4 chipsets in the supply chain, the use of SAS-4 chips will leapfrog current SAS-3. Along with fewer available SAS-3 chips, vendors are being pushed to make tough decisions in terms of allocating production to specific parts due to the overall chip shortage and a demand-supply imbalance. While SAS-4 chipsets offer new functionality that doubles bandwidth and enables faster access to data, the product can downshift to support today's current SAS-3 infrastructures on the front end.

Increased uptake in E1 and E3 drive form factors

E1 and E3 are form factors based on the NVMe interface that are overcoming traditional U.2 2.5 inch SSD form factors in servers and storage systems, thanks to the improved performance and lower latency over traditional SAS-based SSDs. The overall physical design of these products also enables better management of airflow, increasing thermal efficiency. There will be a bifurcation in uptake of these SSD designs, based on different environments and situations. The E1 form factor and its single-port design lends itself well to hyper-scalers and companies that have more node based, erasure-coding protection schemes and architectures, where entire nodes can fail and go offline without degrading access to data. The newer E3 form factor, which includes a dual port design, ensures high availability and will be the winner for NVME Gen5 SSDs in the traditional enterprise storage market. The E3 design will eventually replace U.2 and U.3 products.

Gradual transition to PCIe 5 standards

As cloud-based workloads and new data intensive applications like artificial intelligence (AI) and machine learning (ML) continue to grow, the new PCIe 5 (peripheral component interconnect express) standard aims to double data transfer rates from the current PCIe 4 specification. The physical interface of E1 and E3 drives are ideally suited for the layout and signal integrity requirements associated with this faster standard. This transition won't happen overnight, as the physical layer implementation challenges of doubling data rates could potentially delay adoption. Initial use of PCIe 5 will most likely be focused on I/O (input/output) communication, with the first systems containing PCIe 4 SSDs with the option to include host-side add-in cards that support PCIe 5 connections.

Zadara (Noam Shendar, VP WW Solution Architecture)

Employee preference will drive the speed of business

It's no secret that talent is the main asset for technology companies. So how do tech companies not only attract but retain top-level talent? It's all about adjusting to a new mindset. Post-pandemic, working from home will be the assumption for many employees moving forward. There is an expectation of flexibility in location and hours. And with a younger generation entering the workforce, there is also a shift toward seeking out employers that respect work-life balance and value them as people. The companies that can adapt to this new mindset and embrace talent as a competitive differentiator will be successful. Those that don't will fail.

The sleeper hit of 2022 will be private 5G/enterprise 5G

While most people think of cell phones when it comes to 5G, the real innovation is what 5G can do for the enterprise. 5G allows enterprises to provide ubiquitous coverage that solves all of the weakness of Wi-Fi – including faster speed, more reliability, fewer dead spots, and much lower latency. Additionally, because 5G was built to be a public network, it's inherently much more secure than Wi-Fi. Look for 5G in the enterprise to take off in 2022.

For 5G use cases to succeed, hardware-based platforms will move to software

For 5G applications to perform at their best, speed is critical. Providing edge cloud infrastructure to every major city will enable a whole new set of applications. However, unless infrastructure is in place to support the real-time needs of applications, the results will be less than optimal. For example, when a human talks to a machine, a few seconds delay is okay. But when a machine talks to a machine, any delay can have enormous consequences. For 5G use cases to succeed, hardware-based platforms will move to software to realize the speed requirements that are necessary. This will enable the next frontier of 5G services.

Nelson Nahum, CEO

We will see more VARs expanding their services offerings like MSPs, with a focus on providing complete solutions or an as-a-service model

With technology becoming more fragmented, many enterprises don't want the hassle of dealing with many vendors and instead want easy solutions. That, along with the increased pressure for on-demand, agile services, will lead more and more enterprises to go with MSPs and other channel partners to put together complete solution packages, thereby providing tremendous value and enabling growth in the long run.

MSPs will play an increasing role in accelerating enterprises' transition from on-prem to edge cloud, driving the emergence of a cloud provider in every city

Due to issues such as latency and a shortage of equipment, many enterprises don't want to be dependent on their own data centers and their own people to manage their data. In addition, compliance often dictates where data can be stored.

Enterprises are in need of solutions to help them get to a cloud model, and MSPs who are close by can provide those services.

Supply chain disruption will last at least through 2022, which will force companies to radically rethink their processes

Companies that are adaptable and can improvise to lessen the effects of supply chain disruption are the ones that will survive and even thrive, whereas companies that are too rigid in their processes or not able to think outside of the box will suffer.

The focus will shift away from consistency at all costs to doing whatever works to get products out the door.

Zerto, a HPE company (Caroline Seymour, VP of product marketing)

According to a recent IDC survey, a disturbing 95.1% of organizations have suffered a ransomware or malware attack in the past 12 months, so it's no surprise that the subject is a major topic of conversation in just about every boardroom. While organizations may differ on the particulars of their cyber protection strategies, all should recognize that downtime is one of the most expensive parts of an attack and the average downtime a company experiences after a ransomware attack is 21 days. Continuous data protection can provide organizations with the means to mitigate concerns about data loss and downtime, ultimately enabling them to quickly recover from cyberattacks. To get a holistic view of the challenges around ransomware attacks, I've spoken with several Zerto team members to have them share trends to look out for in the new year:

Recovery needs to be the focal point

It shouldn't be news to anyone that ransomware is the cybersecurity challenge of the moment. It's here and affecting everyone. As we head into a new year, it's important everyone gains a clear understanding of how attackers are evolving and how best to strategically protect organizations from attacks and the impact they have on business.

Attackers are getting smarter, and the payouts are getting larger and more widespread—two alarming trends. If you dissect the anatomy of recent attacks, you'll

see that cybercriminals are targeting companies that can be the most hurt, are the most defenseless, or are the most likely to pay out large sums of money. So, if you are a CEO or CIO of an organization, it's irresponsible at this point not to have a proven ransomware response plan. Any organization can fit the target characteristics for today's cybercriminals, and it's become simply a matter of time until your organization's number is up.

The ability to recover should be a focal point of any security plan. This will be defined by how quickly you can stand up your systems and get them running again. However, in our accelerated digital age largely brought on by COVID, too much can happen overnight or in three to five days for the traditional back up model to be good enough. Recovery solutions need to modernize to fit what the world has become. They need to be continuous and able to keep applications running 24/7 even in the face of disruption or threat. Ultimately protecting all of your data all of the time.

Data protection that meets the demands of the moment can't just be an item on a checklist in 2022. It's a must-have that is a critical investment for every organization. What started with simple encryptions that could be downloaded from a Google search and then executed as a simple ransomware attack is now targeting the most high-profile, sophisticated, and relied upon organizations in the world. Unfortunately, the danger will continue to grow but it's on us to ensure that our resistance to it stays a step or two ahead.

Don't just assume you're protected

It shouldn't be a surprise to say that in 2022 we're going to see a continued increase in the severity and volume of ransomware attacks. In response, we will see a growth in the ransomware-as-a-service market, which is able to propagate new versions and new methods in a much faster way than before. Whether you are a small business or large enterprise, at some point you will be targeted by a ransomware attack that will try to get into your system and encrypt your critical data. We will continue to see an increase in state-backed criminal syndicates that carry out much more tailored and aggressive campaigns.

In 2022, ransomware attacks will continue to evolve and target critical data anywhere. These attacks will not be solely focused on VM data anymore; SaaS and containerized applications will more frequently be in the crosshairs for cybercriminals. We will continue to see container-specific malware attacks focused on data exfiltration, crypto jacking, and encryption.

This coming year and the following will be very dangerous because companies are not mature enough in their approach to protecting containerized and SaaS applications. Many organizations are still trying to figure out where that data lives, and they assume that the vendor-Kubernetes or OpenShift for example-is responsible for protecting their data. Unlike virtualized environments that have disaster recovery

built-in, the reality is that those open-source vendors are limited in that capacity, and enterprises can't always assume their SaaS and containerized data is protected.

Therefore, every organization in 2022 needs a data protection plan in place that covers all data-no matter where it lives.

Disaster-recovery-as-a-service (DRaaS) will become crucial

DRaaS will become a key necessity for many organizations and its adoption will skyrocket. The rise in volume and severity of ransomware attacks and growing threats due to climate change, combined with the financial impact of downtime are driving organizations to take disaster recovery seriously.

Most organizations are looking to offload capital expenditures and only pay for what they use. DRaaS, managed or unmanaged, allows companies to eliminate the costs and administrative overhead of managing and maintaining their own purchased secondary sites. Why refresh hardware every couple of years? Why allocate time, resources, and labor to something that doesn't drive revenue? DRaaS brings organizations a rapid, efficient way to reduce costs and only pay for the applications that need protection.

Apart from capital investments, many organizations do not have the time and administrative overhead required to stand up a secondary data center. DRaaS brings the fastest approach to protect critical workloads.

Adoption of product applications

One trend that will gain momentum into 2022 is the adoption of production applications on containerized platforms by more enterprises.

Many organizations are already using containers for non-production applications. As the underlying technologies have matured to meet enterprise needs and coupled with new applications becoming business critical quickly, the opportunity for deploying production applications directly on containers has arrived. In 2021 many businesses 'dipped their toe in' and started to move more containerized applications into pre-production, but in 2022 trend this will rapidly evolve as the barriers have been removed. We will see a wave of organizations adopting containerization and its many benefits.

Using containers saves time, money, and licensing costs. Any organization switching to a container-first strategy can be more efficient at delivering applications, while lowering costs. However, there will be some challenges along the way: as containers become the norm for production, its mainstream status will make it more susceptible to cyberattacks like ransomware, leading customers to look for data protection capabilities.

Despite its comparatively short life as a new technology, containerization has rapidly become the foundation of the digital era: improving agility and accelerating innovation. In 2022, we'll only continue to see this rapidly evolve.

In-Cloud and SaaS Data Protection

One last thought I'd like to offer is about the acceleration of cloud data protection. Most organizations today employ a cloud first strategy, and we continue to see that trend accelerate. According to Gartner, more than 45% of IT spending will have shifted to cloud by 2024 (up from 33% in 2020). This means more and more workloads and applications are moving into the cloud creating a need for disaster recovery to protect against disruptions there. Lastly, organizations must ensure that their SaaS data is fully protected. A common myth is that SaaS data is protected by the SaaS vendor. It is not! It is the responsibility of the organization to protect against human errors, malicious attacks, or any other disruptive events.